MULTIMODAL TRANSPORT PRINCIPAL AND OPERATION



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PREFACE

The purpose of this book is to give a complete picture of the Multimodal Transport System so that those concerned with ,River ,Trucks,and Rails transport,can each see their own specific field of activity in perspective

Where possible we have quoted actual technical specifications for several modes of transport showing on which factor the multimodal system could be integrated .

This book forming the PART-- I of the multi modal transport system .It covers the technical subjects in the syllabus for those studying various levels in transport

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CHAPTER 1

INTRODUCTION

Many nations are looking forward to a system serving the transport operations in order to save a considerable amount of costs. No doubt, water transport, sea and rivers forms the best media of transport due to the economical volume of cargoes transported on one vessel.

For this reason as well as others, many countries started to review the status of their water streams, such as rivers, lakes and canals and their validity for safe economical transportation system.

This chapter is devoted to a consideration of various technical and economic aspects of inland waterway navigation system.

It sets out also, a general procedure which indicates systematically how planning studies for the construction or improvement of waterway can be organized. The most important step in the procedure is listing the measures, which can be taken to improve the existing situation. It is essential that the design team devote a good deal of attention to this issue. An inventive selection from the options can often result in considerable cost savings.

CHAPTER 2

2. THE RIVER NILE HYDROGRAPHIC PRECONDITIONS

2.1 The River Nile tributaries and its yield from its different sources

The river Nile dominates the northern part of the African continent. It is the second longest river in the world being about 7600 km long. When flowing in its long voyage northwards from its sources in the south near lake Tanganika at latitude 4 degrees up to its mouth at the Mediterranean at latitude 35 degrees north.

(Abullata 10 p. - 202) The Nile basin area is estimated to be about 2,900,000km square, its course traverses through the countries of Uganda, Kenya, Tanzania, Rwanda, Burundi Zaire, one third of Ethiopia as well of course, the Sudan and Egypt.

Over this great spatial extension, civilization, languages, habits and religions present there.

The Nile has two main sources, we call them main sources because there are others having relatively little yield at present as compared to the main ones. These are:

1. The Equatorial lakes plateau.
2. The Ethiopian plateau.

2.2 Sources of yield from the equatorial lakes plateau Lake Victoria

Its area amounts to 67,000 km square with a surface level of 1132.6 m above sea level, white the area of the rain fall on catchment area that feeds the lake amounts to 195,000 km square.

The annual rainfall rate on the lake is 1.5 m per annum. Therefore the amount of annual direct rainfall on the lake is 1.5 x 67.000 = about 100.000 milliard cubic m.

Annual rainfall on the catchment area around the lake is 1.15 m. The percentage of rainfall matter flowing to the lake reaches about 8% while the remaining 92% is lost by evaporation or infiltration.

Therefore, the net annual flow to the lake from this source is:

195.000 km squares x 1.15 m x 0.08 = about 18 milliard cubic m.

Thus the total annual water inflow to the lake becomes

100 + 18 =118 milliard cubic m

The actual results of recent meteorological studies show that the lake's evaporation rate is 1.26 m per annum. Thus the lake's annual loss through evaporation is

67.000 × 1.26 = about 84.5 milliard cubic m

So, the annual netwater yield of the lake is

118 - 84.5 = 25.5 milliard cubic m

2.3 Victoria Nile between lake Victoria and lake Kyoga

This part of the river is the only outlet from Lake Victoria, through which the lake's water flows over several waterfalls. The first Ripon fall and the second is Owen falls. Both are near Tanga City in Uganda.

The average drop over these falls is about 2Om. in the early fifties , Egypt and Uganda participated in constructing a dam to benefit from the falls for the generation of electricity for Uganda

This is what is known at present as Owen Falls Dam.

This dam will also be used for storage purposes in the lake as part of a master project for storing in the equatorial lakes.

The Victoria Nile flows over successive waterfalls until it reaches Namasoguli City 80 km away from the outlet of Lake Victoria.

At this point, the river matters are discharged into Lake Kyoga.

The total drop in water level between the two lakes amounts to about 102 m.

2.4 lake Kyoga

This lake differs from Lake Victoria, in that vast swampy areas surround it.

The area of the lake itself is about 1,760 km square. The area of the swamps around it amounts to about 4,510-km square as for the catchment area of Victoria Nile and Lake Kyoga it amounts to 75.00 km square. The rate of annual rainfall is about 1.29 m.

Thus the volume of annual rainfall over the lake and the surrounding swamps is

6270 x 1.29 about 8 milliards cubic m

Rainfall on the catchment area around the lake and its swamps amounts to 3 milliards cubic m per annum. So the total amount of waterfill owing into the lake, and that which falls directly on it; is 11 milliard cubic m.

The annual evaporation rate is about 1.2 m from the lake surface while it is 2.23 m from the swamps. Thus, the evaporation losses are:

1760 x 1.2 + 4510 x 2.23 = about 12 milliard cubic m.

This means that the net inflow to the lake itself and into the Victoria Nile, apart from Lake Victoria discharges is

11 - 12 = -1.00 milliard cubic m per annum.

In other words, we can say that Lake Kyoga accords to these calculations is a source of water losses amounting to an estimated -1 milliard cubic m per annum. Whereas the average annual discharge into lake Kyoga from lake Victoria is 23.5 milliard cubic m.

The average annual discharge flowing out of the former lake is about 22.5 milliard cubic m.

2.5 Victoria Nile from the outlet of Lake Kyoga at Massindi port to the Intel of Lake Albert

The Victoria Nile flows from Lake Kyoga in natural course at a normal gradient a distance of 80 km until it reaches Kamdini. From this point its water flows over waterfalls ending at Murchisan falls one hundred km from Kamdini. The total drop between Lake Kyoga water level at Massindi port and the intel of lake Albert downstream of Murchisan falls, amounts to about 409 m.

2.6 Bahr Elgebel Sudd Region

At the northern reach Mongola, the average eater level drops from 440 m to 425 m at a distance of 74 km from Mongola, with an inclination of about 20 cimkm. Swamps cover a wide area on the western side of the river between Tombe and Bor, a distance of 67 km. This area is crossed by the Alyabe River, north of Tombe , only to flow back into it again, at a point about 16 km away from Tomb . North of Bor, the river course moves westwards so

that swamp area now lies to the east and dry lands to the west of river. At distance of about 50 km north of Bor, Bahr Elgabel waters drain eastward through several intels into a separate branch, known as the Atem river. this branch traverses the eastern swamps , until it gradually approaches dry land east of the swampy area. 80 km away from its point of origin, the Atem runs adjacent to the eastern side of Jonglei town.

It then flows towards Bahr Elgebel into its discharges through several out flows, the last of which is located about 200 km north of the point at which it bifurcated from Bahr Elgebel and about 120 km north of Jonglei Water drains from the lower extremities of the Atem river northwards. Joining other tributaries from the eastern side of Baher Elgebel itself, to form the upper Bahr Elzaraf. These waters, gradually increasing in quantity as they are supplemented by discharges from eastern Khors constitute the main source of Bahr Elzaraf yield . At the western side of Bahr Elgebel , there are a number of subsidiary Khors where water drains in it. The most important of these is Peaks channel, which takes its water 325km from No, after which it flows back into Bahr Elgebel near Bahr Elzaraf, 295 km from Lake No.

The average surface of the Bahr Elgebel swamps is about 7.200 km square. The river losses in those swamp half of its yield through seepage, evaporation and transpiration.

2.7 Bahr Elghazal Basin

Adjacent to this basin on the southern side are the borders of the Sudan Republic and Congo. The border heights contain the upstream reaches of the rivers Taoari Yei, El Na'am, Meridi, Tong and the tributaries of the river Sueh Which is one of the main branches of the Jur river. At the southwestern end of Bahr Elghazal basin, bordered by the Sudan and the Republic of Central Africa are the sources of the tributaries of river Busseri. As well as the Pongo , the upstream tributaries of river Loll and the southern tributaries of river Loll and the southern tributaries of Bahr El Arab.

The northern part of Bahr Elghazal basin borders the southern slopes of the Mara Mountains, in which is located the source of the northern tributaries of Bahr El Arab, the area of Bahr Elghazal basin is estimated to cover about 526.000 km square, of which about 40.000 km square constitute swamp zones.

The average of rainfall on the basin to about 0.9 m per annum, while the rate of evaporation is estimated at about 2.8 m per annum.

The most important rivers of the area are:

1. Bahr El Arab, with a basin area of 210.000 km squares. It forms the northern half of the catchment area basin of Bahr Elghazal branches. The southern outlet of this river where it flows eastwards towards Bahr Elghazal swamps consists of virtually independent pools or marshes. There are no records or data for the upstream tributaries of this river.
2. River Loll, the average annual discharge of which is estimated to be about 4.3-milliard cubic m at Nyamlell.
3. River Pongo, the southern branch of river Loll its average annual discharge is estimated to be about 0.7- milliard cubic m.
4. River Jur, which is considered the most important tributary in the area. Its average annual discharge at Wau City is estimated at about 5.3 milliard cubic m.
5. River Tonj, the source of which is in the south of the basin. Its average annual discharge is estimated at about 1.1 milliard cubic m.
6. River Gel, the source of which is in the south of the basin. Its average annual discharge is estimated at about 0.4 milliard cubic m.

Therefore, the total average annual discharge from the above mentioned Six branches is about 11.8 milliard cubic m. All of them discharge into the swamps at Bahr Elghazal , while off its way to its outflow at lake No, crosses a swampy region in which it loses almost all its water. The volume of water reaching the White Nile is only about 0.5 milliard cubic m / year.

As for the source for the other two rivers El Na'am and Yei, It lies in the southern part of the basin, through their courses ultimately low toward Bahr Elgebel.

The annual average discharge of El Na'am river is estimated at about 0.5 milliard cubic m. The annual average discharge of river Yei is estimated at about 2 milliard cubic m at Mundi city, where this water is however lost in the swamps adjacent to Bahr Elgebel and the western side north of Shamby city.

There are some other tributaries that also flow toward Bahr Elgebel, where they lose their water in its swamps. The total of the annual discharge is estimated at about 0.8-milliard cubic m.

In short, we can assume the total average discharges from the tributaries at Bahr Elghzal amount are not less than 15.1 milliard cubic m per annum, almost all of which is lost in the swampy area.

CHAPTER 3

3. PLANNING PROCEDURE (SEE FIG. 1& FIG. 2)

Figures land 2 show an universal technical and economic planning procedure which can be applied to any design for a new waterway or waterway improvement scheme. The procedure can be divided into three phases:

Phase 1: Collection of data, both technical and economic (step 1 - 6).

Phase 2: Rough listing and evaluation of possible measures (step 7-13).

Phase 3: Selection of the best measures (steps 14-18).

The following comments may be made on the procedure.

a. In many cases it is not necessary to follow the entire planning procedure step by step: some steps may be omitted. Even then, however, it is worthwhile to use the procedure so those steps are not forgotten.

b. It often happens that the technical and economic data needed at the beginning of a study are not available. This is not a serious problem. To avoid unnecessary work a rough estimate of the effects of the various measures can be made and a general idea formed of which measures are promising or otherwise and what additional data are needed. Detailed calculations etc, can then be made for the most attractive design. The various steps in the planning procedure sometimes have to be passed through several times during this selection process.

c. The most important step in the planning procedure is step 7. This involves listing the measures, which could be taken to improve the existing situation. It is essential that the design team devotes a good of attention to this and adopts a creative approach. An inventive selection from the options can often result in considerable cost saving which might otherwise passe unnoticed.

Step 5: This entails evaluating the available data and expectations for the future. Note should also be taken of any gaps in knowledge: additional information may be collected as a result (step 6)

Step 6: This entails establishing the dimensions of the entire infrastructure and fleet. Fig. 2 shows this in diagrammatic form. First (8A) the restrictions in the area under consideration are examined, i.e. such things as the physical restrictions of the existing waterways and the possibility of changing them; the nature of the soil; the environment; human aspects; the availability of dredge's, construction equipment and material and transportation; and the possibility of navigation at night. On this basis one or more" design ships are selected and a rough indication of the vessel mix in the remainder of the fleet is obtained (step 8B). This means that the total number of ships and the distribution of the various types with dimension, engine size and characteristics are known approximately. (See figure 1)

The dimensions of the fairways, engineering structures and harbours are then based on the selected vessel mix (8C, 8D and 8E) and supply and discharge are coordinated. From the data on the types of ship, sailing (8F) and fairway dimensions the effect on beds and banks can be established (8G), and from this data on the bank and bottom protection needed (H). Steps 8G and 8H yield a number of promising designs for entire infrastructure (81). Given this, the measures needed for safe and expeditious navigation (buoys, positioning system, Vessel Traffic Management System, operation and energy consumption of locks and bridges, admittance policy, etc.) and the maintenance work required (dredging, locks and bridges, bank protection) can be determined (8J). The next step (8K) is to decide what effect other uses (e.g. irrigation and flood control) have on the design (step 8 concludes with computations of the costs of the various designs: the capitalized costs of maintenance and operation should be taken into consideration, as well as the cost of construction.

Step 9: This entails computing the capacities of various components (locks fairways, overtopping and storage facilities).

Step 10: Various times follow from the computed capacities, e.g. waiting times at locks and bridges, navigation times and ships' waiting and loading I unloading times in harbours.

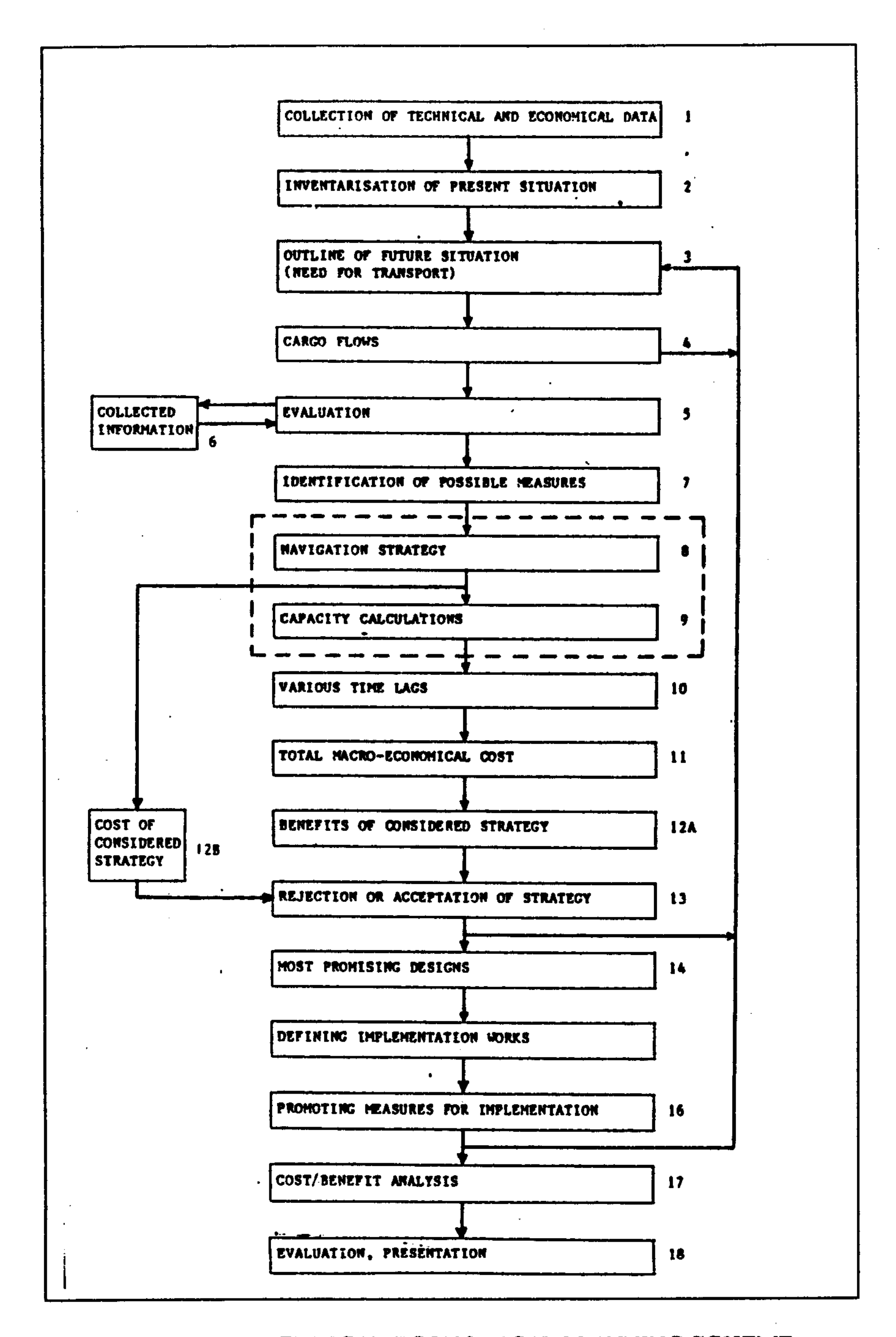


Fig. 1: TECHNICAL-ECONOMICAL PLANNING SCHEME

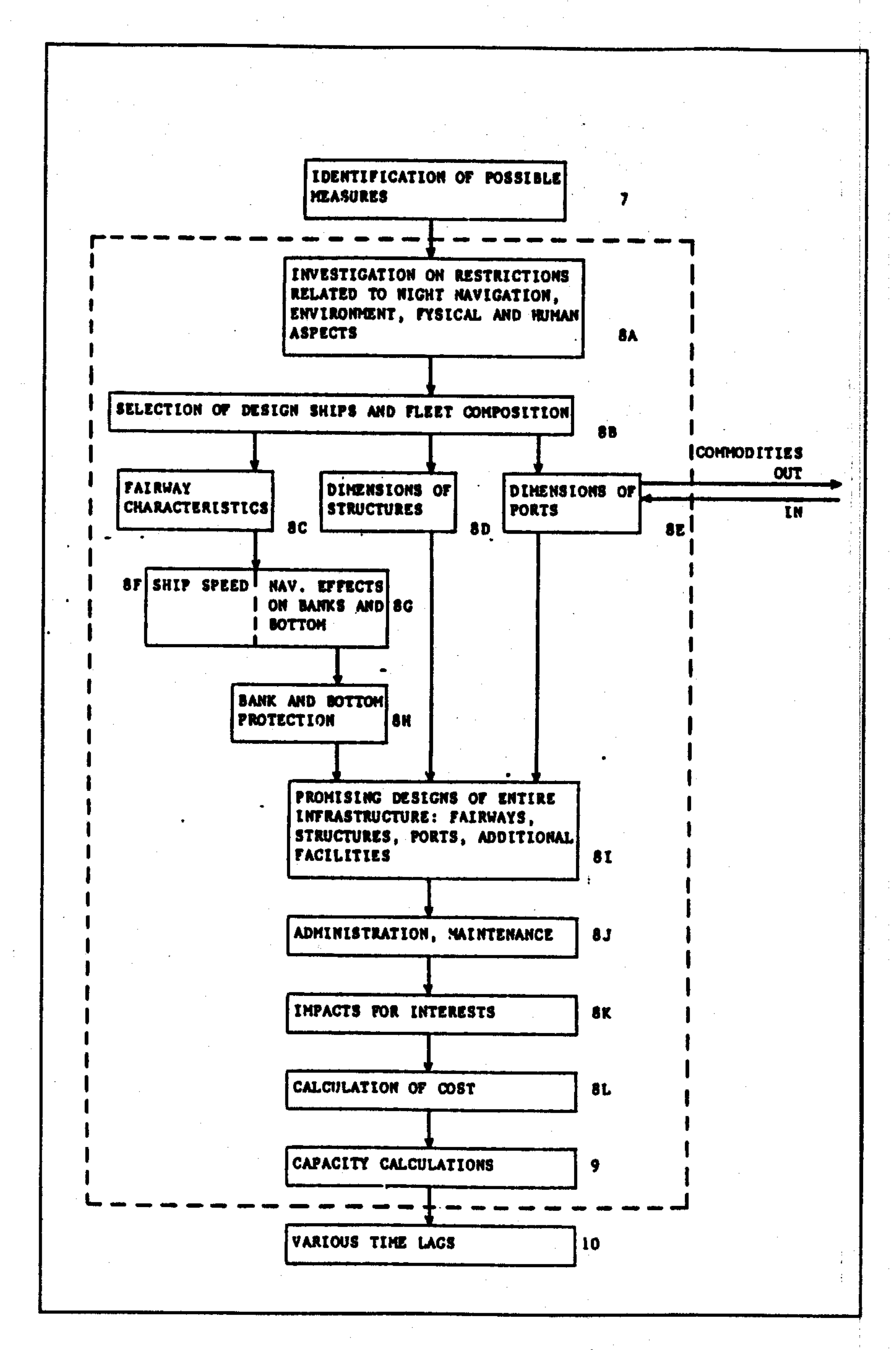


Fig. 2: SCHEME FOR THE DIMENSIONENING OF INFRASTRUCTURES

CHAPTER 4

4. DEVELOPING WATERWAY SYSTEM:

4.1 The applications of planning procedure (see Fig.3)

The planning procedure outlines in Chapter 2 is used as follows in the Netherlands and in Germany.

1. Technical and economic data which may be useful for the navigation of the waterway network are collected in sufficient quantity on a continuous basis (step 1).
2. The authorities estimation to the forecasts of traffic and traffic volume on the entire waterway network, taking account of such things as:
   a. Expected economic developments in the nation and a number of neighbouring countries;
   b. The hydrographical conditions of the water stream.
   c. The marphological statement of the water stream a. and b. The navigational marks to facilitate the transportation system.
   d. The cost of transport by road, rail and water and the resulting model split for each mode of transport and type of freight.

The effect of the improvements in the waterway on the cost of transport and the traffic volume can be computed approximately with this model, which is also an aid to locating future bottlenecks in the waterway network.

3. The government can design a plan on waterways for a period often years.
4. This plan will set out such items as:
   a. The master plan for the next 10 years including all processes may be needed to navigation system and control system, too.
   b. The maintenance plan for the next 10 years to maintain the navigational marks and salvage units, fire fighting and dredge's .
   c. The investment plan for the next 10 years to increase the investment and considering the replacement of units and marks.

d. The plans for the next 10 years to increase the rate of cargo by decreases voyage time.

e. The plans for the next 10 years to design new models for river vessels to increase the amount of cargo per one vessel without increasing the draught.

f. Programs for the next 10 years for replacing , renewing the navigational system.

g. Programs for developing the system of data to riverbank to face the needs of the future.

5. The Schemes mentioned at 4C are elaborated, analysed and developed separately, following the entire planning procedure outlined in chapter 2 once more.

6. The feasibility studies mentioned at 4. Are also carried out separately. The results may be incorporated in a subsequent ten-year plan, or they may give rise to a more detailed project analysis , or the abandonment of the scheme.

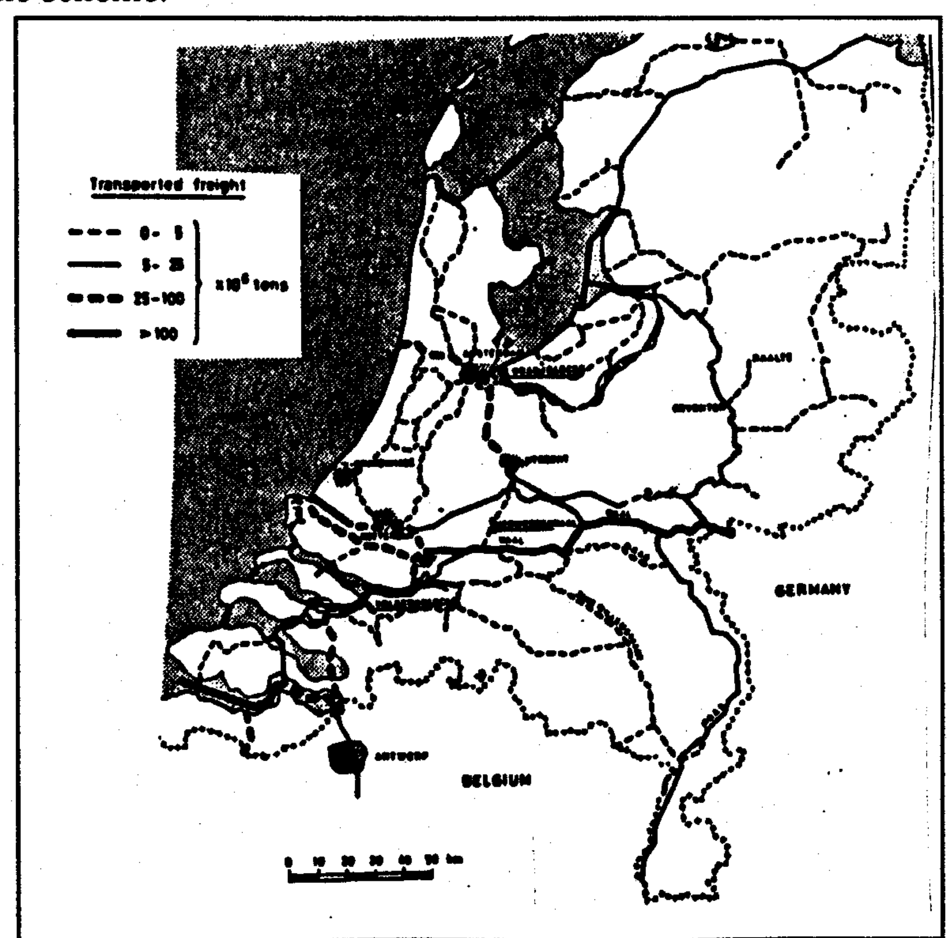


Fig. 3 Transported Fright by Inland Transport System

4.2 The upgrading of existing inland navigation system: Economic aspects

Two questions arise as regards the upgrading of an existing waterway network:

1. Under what conditions is it economically feasible to upgrade a waterway?

2. How can the investment be made to yield the best returns?

These questions are dealt with systematically below on the basis of various studies and experience in recent years.

1. New waterway construction

The construction of an entirely new waterway may be economically feasible only if three conditions are all satisfied.

a. Large quantities of bulk freight are transported between two places, or this is expected to be the case in the future.

b. The two places are not connected by a waterway, or a time-consuming detour has to be made using existing waterways.

c. The new waterway can be constructed over relatively flat terrain, crossing existing road railroad connections and built-up areas to only a limited extent.

The first condition must be satisfied to provide sufficient cost-savings. The second one is to justify a new connection.

The savings are then created by the changeover from road or rail haulage to the less expensive waterway transported or by saving time and energy for shipping.

The third condition is decisive in ensuring that the investment (in such things as locks, bridges, earth-moving work and expropriation costs) is not too high.

During recent years a number of cost-benefit analyses to determine the possibilities of constructing completely new waterway have been carried out in the country.

Conclusion:

A country with such a fine-meshed inland navigation system as the Germany and the Netherlands is so well served with waterways that the construction of an entirely new waterway is likely to be economical only in exceptional cases.

2. Improving waterways with a high Volume of traffic

Here those waterways are first selected which carry a lot of traffic, or may be expected to do so in the future. Improving them is generally likely to result in a considerable saving in transport costs, especially if the waterway in question is accessible only to ships of a limited cargo capacity, and after the improvement either this capacity can be increased substantially or there will be a considerable time-saving.

The advantages of any change in the model split from rail and road haulage to inland shipping should also be taken into account. On the other hand, such improvement usually requires large investments. The results yielded by this method, depending on the rate of discount applied, turn out sometimes in favour but more often not in favour of improvement.

An investigation of this kind is the still unfinished study of the possibility of admitting six-barge push-tow units (16.500 tons) to the Rotterdam-Germany route (Fig.4) , where four-barge units (11.000 tons) are currently permitted.

3. Low- budget improvement (see Fig. 4 & Fig. 5)

This method entails investigations whether there is a possibility of reducing the transport costs with a comparatively small investment.

__*Examples are:*__

*a. Improving local bottlenecks: for an example see 4b, the Oranje locks. **

b. Increasing capacity by imposing one-way traffic (for the largest units)

__*Example 1:*__ Two-barge push-two units on the Mass.

So far only ships less than 12 m wide and 100 m long (carrying capacity approx. 2.500 tons) have been permitted on the Mass. A study has show that a large part of the river is suitable for two-barge push-two units (capacity approx. 4.000 tons) provided these units are subject to one-way traffic on certain narrow parts of the river.

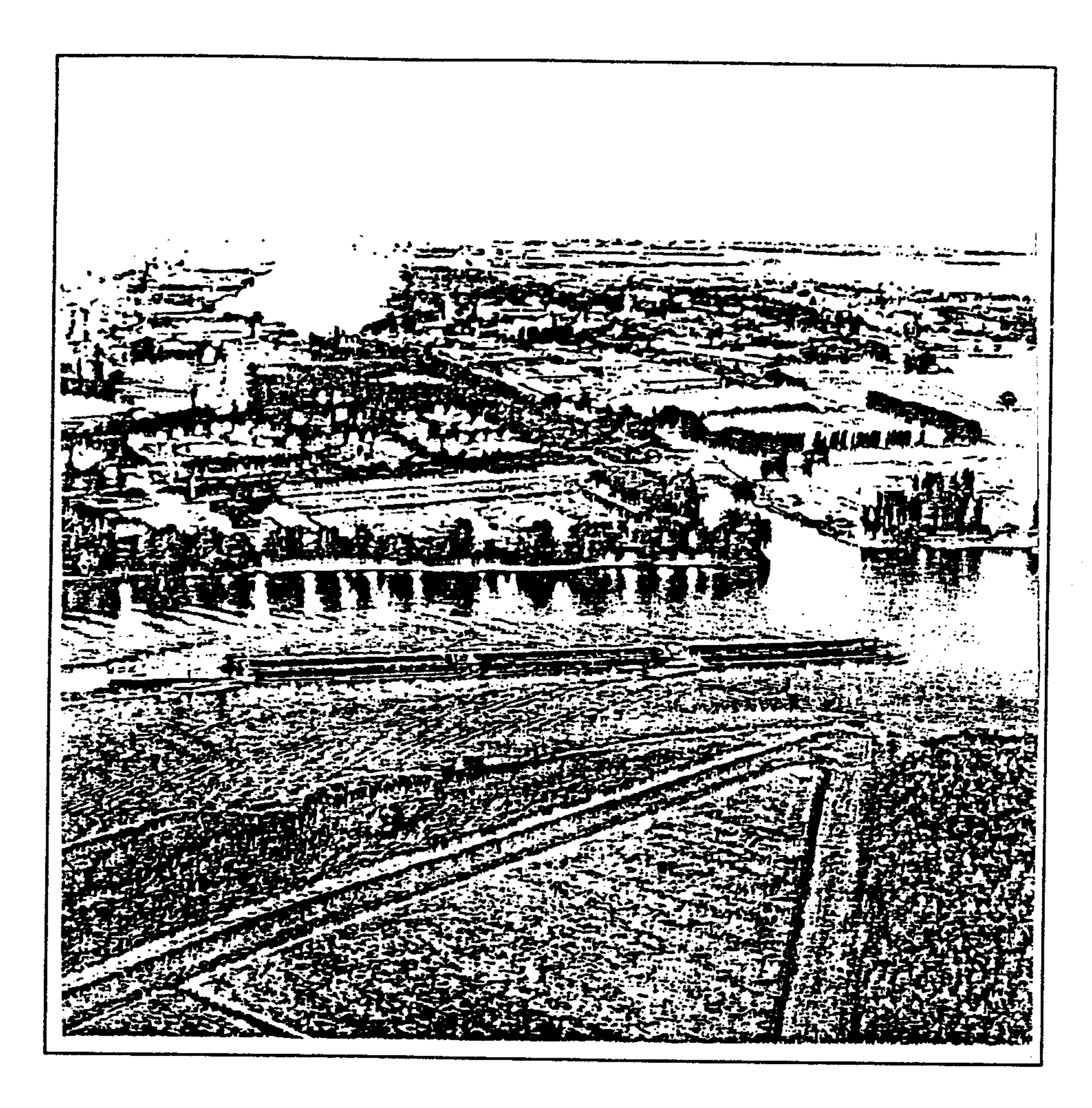


Fig. 4: Tests with Six-Barge Push-Tow Units (16500 Tons)

Example 2: The Deventer -Raalte Canal (see Fig. 5).

At present this canal is navigable only by small barges (peniches: 300-ton vessels) loaded at most a draught of 1.45 m, and able to carry only 160 tons of cargo. (For the geographical situation, see fig. 3) In the Dutch situation a vessel is unable to complete with road haulage, if it can only carry such a small amount of cargo.

The canal has consequently lost traffic. Four options were studied:

- Closing the canal;
- Improving the canal to make it a proper 300-tons route;

- Maintaining the present situation; and
- Improving the canal to make it a 300-ton route for one-way traffic using the convoy-system.

The investigation shows the option as the most attractive.

The benefits almost equal a full-scale 300-tone route, but the investments for the enlargement of the cross-section and bank protection are lower. Nevertheless the canal will probably be closed in the future, since national and local authorities cannot reach an agreement over the division of the cost.

Obviously in many cases one-way traffic is not very desirable from the point of view of traffic flow, nor is it always feasible from the navigational point of view.

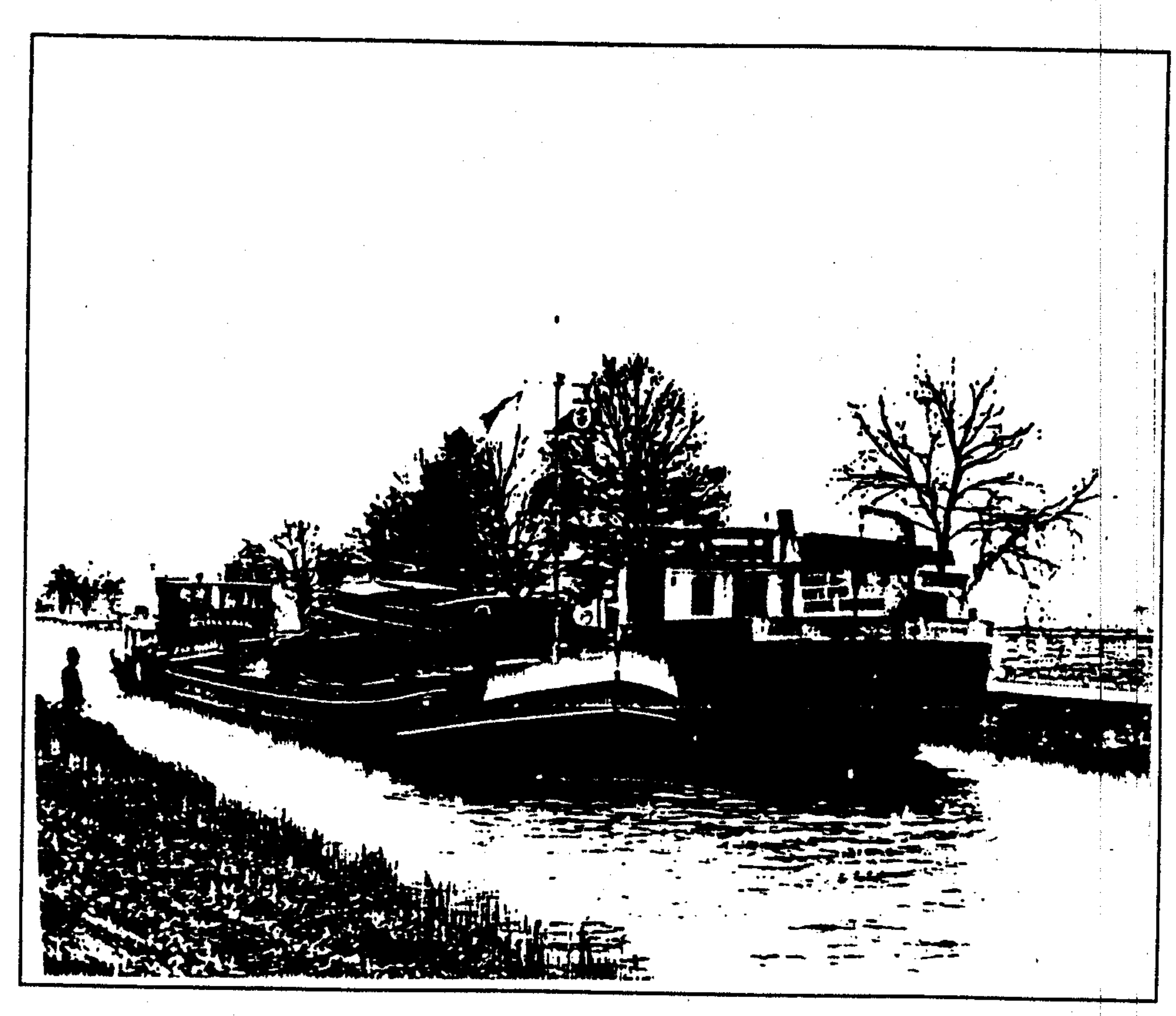


Fig. 5: Encounter on the Deventer-Raalte Canal

Nevertheless it can provide a good way to increase the admitted carrying capacity of the largest vessels using a waterway, if increasing the size of the waterway is expensive or undesirable, e.g. if the waterway crosses a town.

In this case some form of traffic regulation is required. (see the signs and signals on inland waterways). Moreover, previously it must be established whether the waterway has sufficient capacity to cope with the traffic; in some cases waiting facilities must additionally be created for vessels.

c. Increasing capacity by using small push-tow units

There are a large number of small waterways in the Netherlands, which at present are accessible to vessels of a limited capacity (300 – 600 tones). The dimensions of the lock chambers usually determine the largest size of vessel, which may be permitted on these waterways. In the short term a considerable increase in capacity could be achieved if navigation with push-tow units consisting of two series-coupled vessels could be permitted. At a lock the vessels would have to be uncoupled and then the two vessels would have to pass through separately. The same procedure might be necessary on sharp bends.

At narrow bridges the guiding structure would have to be improved. Crosswinds would be a major problem, since the longer push-tow units need a fairly large path width as a result. Instead of a stiff coupling a flexible coupling in combination with central steering, allowing both units to turn independently, might be considered also.

d. Reading Keel clearance

In many cases the sill depths of lock entrances determine the admissible draught of vessels on a waterway. Currently is under investigation whether the admissible draught on the Mass with her many locks can be increased from 2.8 to 3 m. Caution is called for, since this would increase the risk of vessels touching the sill when entering the lock. To reduce this risk an echo sounder has been developed to measure the draught of vessels before they enter a lock.

4. The capacity of existing locks (see Fig. 6)

a. Traffic Volume

When the amount of traffic increases locks are frequently unable to cope with it any more. To overcome this problem a new lock chamber of the same size, or at slightly greater expense a larger one, can be built. In such

cases it is often economical to increase the admitted carrying by enlarging not only the locks but also the cross-section of the adjacent waterway.

To increase the capacity the following can be achieved:

- Speeding-up the movement of gates and valves;
- Opening the gates just before the water levels coincided;
- Improving the operating, information and communications systems.

Two conclusions of general application can be draw from the volkerak example:

1. Every lock, or for that matter movable bridge or one-way traffic shipping route, has a kind of turning point. If traffic volume remains below this point , there is virtually no demurrage time ; if it rises above it , the demurrage time suddenly starts to increase sharply as the amount of traffic rises (see Fig. 6) . If traffic is increasing sharply and measures are delayed until the turning point is reached, there is a danger of being too late.
2. Turning point has almost been reached, it is worthwhile to investigate whether the operation of the locks can be improved.

   This can often be done at relatively little expense, in some cases enabling a much larger investment to be postponed for some years.

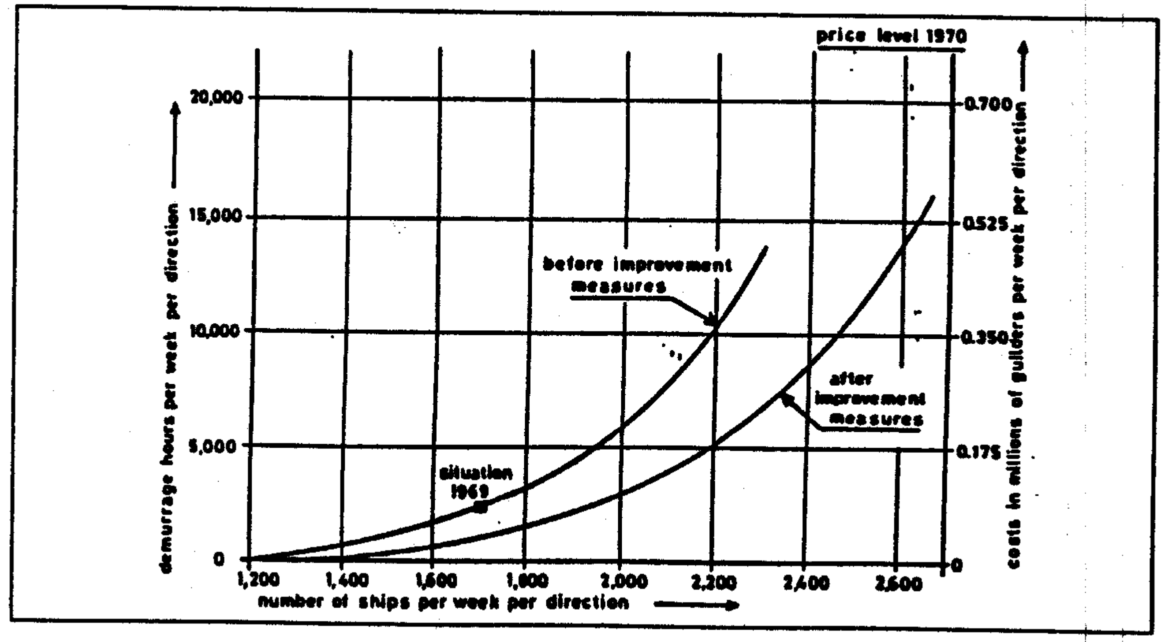


Fig. 6: VOLKERAK Locks Demurrage Hours and Cost as Function of the Capacity and Number of Ships Passing.

b. <u>Increasing vessel size (see Fig. 7 & Fig. 8)</u>

Even if the amount of freight carried remains constant or decreases, a lock complex may become overworked, thus making it economical to increase its capacity.

Example: The Oranje locks

This are accessible to 1.500-ton vessels and are situated on a route which is otherwise accessible to two-barge push-tow units (of 5.00 tons) The complex comprises three chambers, the central one 85 m long and the other two 65 and 70 m long (see fig.7). It is heavily loaded. The average size of the vessels passing through is 675 tons at present, but there is a sharp increase-taking place in vessel size.

Consequently more and more vessels which can only pass through the central chamber are arriving. If this trend continuous there will be a sharp drop in locking capacity (see fig. 8) and the complex will be overworked. Within a short time work will start on the construction of a new larger chamber, accessible to two-barge units, which a study has shown to be economical.

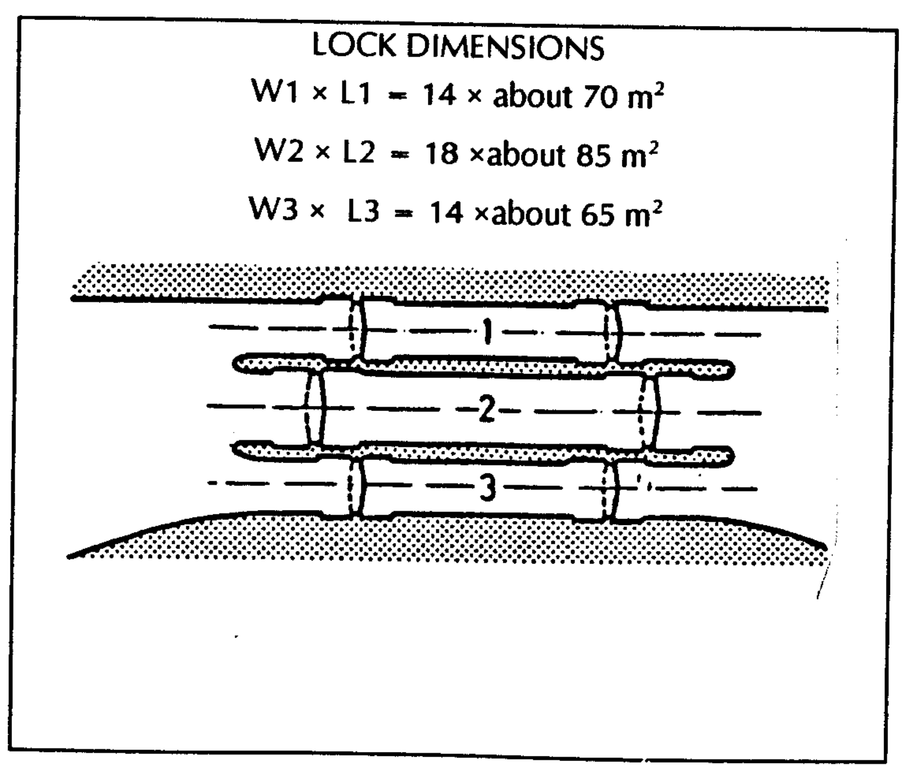


Fig. 7 LAY OUT ORANJE LOCKS

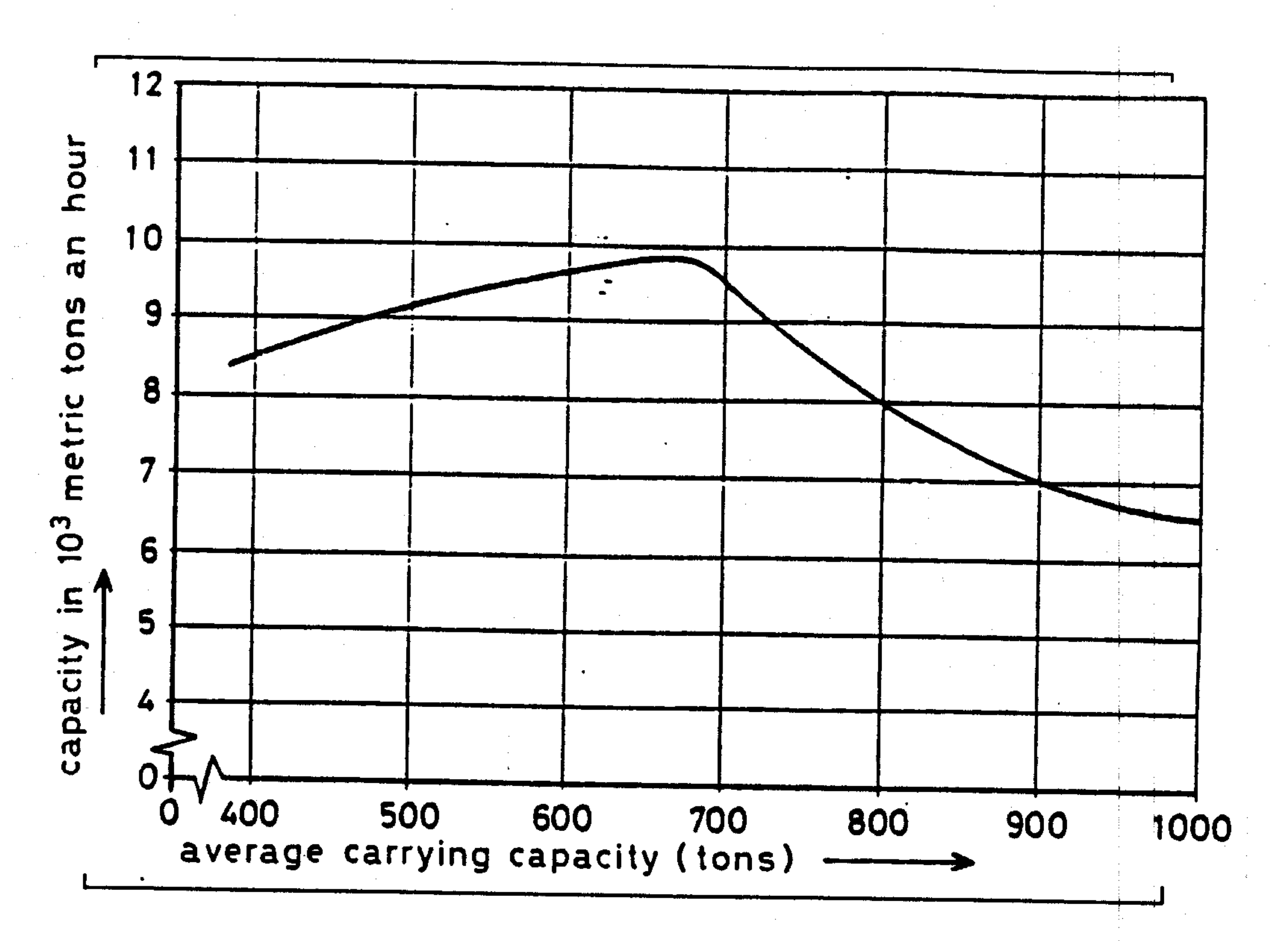


Fig. 8: ORANJE LOCKS, RELATION BETWEEN LOCK CAPACITY AND AVERAGE CARRYING CAPACITY

5. Obsolete waterways:

Some of the Dutch waterways are over 100 years old . As the engineering structures get older they need more and more and more repairs, thus increasing the cost of maintenance.

They can also break down and cause long hold-ups to shipping at unexpected times. When this is the case the options are:

- To close down the waterway;
- To continue to operate it as before;
- To restore the engineering structures;
- To enlarge the waterway.

As long as a reasonable amount of freight is being carried on a waterway (over ½ million tons a year), closure is likely to be uneconomic. The cost of

upgrading in some cases is not much greater than that of the other options. On the other hand an improvement scheme can often produce a considerable saving in transport costs: in such cases it may be economical.

6. Multi- Purpose projects

An improvement scheme can produce a reduction in the cost of transport as well as other advantage to the community. If consideration is given to these the benefits from a scheme can sometimes be increased considerably.

- Engineering structures in bad repair owing to age would be replaced;
- Haulage costs would be reduced;
- The cost of maintenance (bank protection, locks , bridges and dredgers) would be reduced ;
- Improved water discharge would benefit agriculture;
- There would be positive effects on employment (work on the improvement of the canal and possible settlement of new industries);
- There would be manpower saving in the operation of locks and bridges;
- The subtraction of fixed bridges for movable bridges would reduce the cost of waiting for land traffic;
- Excavated sand and clay could be sold;
- Facilities for pleasure craft would be improved.

7. The operation of locks and movable bridges

Many locks and bridges every where are still operated in an old-fashioned way. A number of studies carried out in recent years have shown that labour-saving methods of operation can often produce a major reduction in cost. These include the following:

a. Remote control

By this means several locks or bridges can be operated at the same time from a central post , if necessary using visual aids such as television or radar.

Example: Mainz- Gustavsburg lane in Germany

The lane is 123 km long contains two locks, all of them operated on the spot. Every year the canal carries some 11.500 commercial vessels with a total carrying capacity of 2 million tons and 10.000 pleasure craft. Thirty-

two operators are required; remote control would produce a manpower saving of fourteen, and the benefits would far exceed the cost according to a cost-benefit analysis (with a 10% rate of discount) .

b. More efficient operation of locks

For an example see Fig. 4 the Gustavsburg locks.

c. Mobile operation

Here is the operators travel with a vessel or group of vessels and operate the locks and bridges: this system is used on a number of waterways in the Germany.

d. Use of part-time operators

Because of the number of pleasure craft the traffic on some waterways is particularly high during the holiday season, just the time when few operators are available. The use of part-time operators (working students; waterway employees who do other jobs in the winter) may be economical hire.

e. Self-service

This entails the crews themselves operating the locks and bridges. Currently some designs for modern self-service locks are being made in the Netherlands too

f. Automatic operation

In the Netherlands the locks and bridges are operated entirely by electronic equipment, this is automatically triggered by the approach of a vessel or vehicle. There is no experience with such system on Dutch waterways as yet.

g. Substitution of fixed for movable bridges.

This is sometimes found to be economical.

8. Standardization of Construction Methods & Maintenance

In some cases standardization of engineering structures and bank protection, taking account of both the interchange ability of components and construction and maintenance costs, can result in major savings. In this connection a study of the construction and maintenance costs of various types of bank protection is soon to be under taken in the Netherlands.

9. The Effectiveness of the Fleet

The following measures are examples of those that can be taken to ensure that shipping is able to use the waterway network as effectively as possible:

a. Providing information to shipping e.g. on expected condition such as depth, icing, and obstructions.

b. Providing beacons and buoys to mark shallows (see appendix)

c. Facilities for 24-hours navigation (radar beacons and 24-hours manning of locks and movable bridges).

d. Reading waiting in harbours and at locks and bridges.

In many countries a great deal of time is wasted when loading and unloading, and waiting for cargoes and at locks and bridges.

e. Exchange of information between locks

An information system which enables information on passing vessels to be exchanged between the various locks is currently on trail in the Netherlands. This enables the operation of the locks to be geared to the shipping expected, thus reducing passing vessels' waiting times and at the same time reducing the energy costs of pumping water back into the upper reaches or of salt water/fresh water separation systems. It also gives a general idea of the whereabouts of vessels carrying dangerous substances.

CHAPTER 5

5. DEVELOPING GUIDELINES FOR THE DESIGN OF WATERWAYS, LOCKS AND BRIDGES

5.1 Introduction

The ECMT (European Conference of Ministers of Transport) made a recommendation in 1954 that the Western European waterways should be divided into five classes. A waterway is in a particular class if it is accessible to vessels of the standard length and standard beam appropriate to that class. The Netherlands subsequently added a class VI for waterways accessible to four-barge push-tow units with a cargo capacity of approx.10.000 tons.

As well as a number of major waterways, the Netherlands has an extensive network of small and medium-sized waterways (300-1.500 tons) . The accent developing the waterway network is on improving the major waterways, but it frequently happens small and medium-sized waterways are improved or require other measures such as the construction of new bridges.

Three problems were experienced in this connection:

1. There were no general applicable guidelines for the design of waterways and engineering structures, with local differences as a result.
2. The Standards applied to the admittance of vessels were not the same throughout the country.
3. Investigation indicated that the dimensions of present-day vessels differ from the ECMT standard dimensions.

(European conference of Ministers of Transport).

To solve these problems it was decided to draw up guidelines for the design of small and medium-sized waterways. This chapter gives a summary of these guidelines and considers various aspects of their drafting.

5.2 Design ship dimensions (see Fig. 9 & Fig. 10)

First the dimension of the inland shipping fleet active in western Europe were analysed with the aid of the Rhine Shipping Register. The analysis showed that the widths of the majority of vessels corresponded to one of the standard ECMT beam sizes (see Fig. 9). These dimensions were obviously worth retaining, therefore. It was further found that a reasonable number of vessels had a beam of approx. 7.20-m, which happens to be the maximum admissible beam on certain not unimportant Dutch waterways. It was therefore decided to add this to the ECMT classification as class IIA. The length, draught and clearance heights of vessels were generally found to be larger than the standard ECMT Dimensions (Fig. 10).

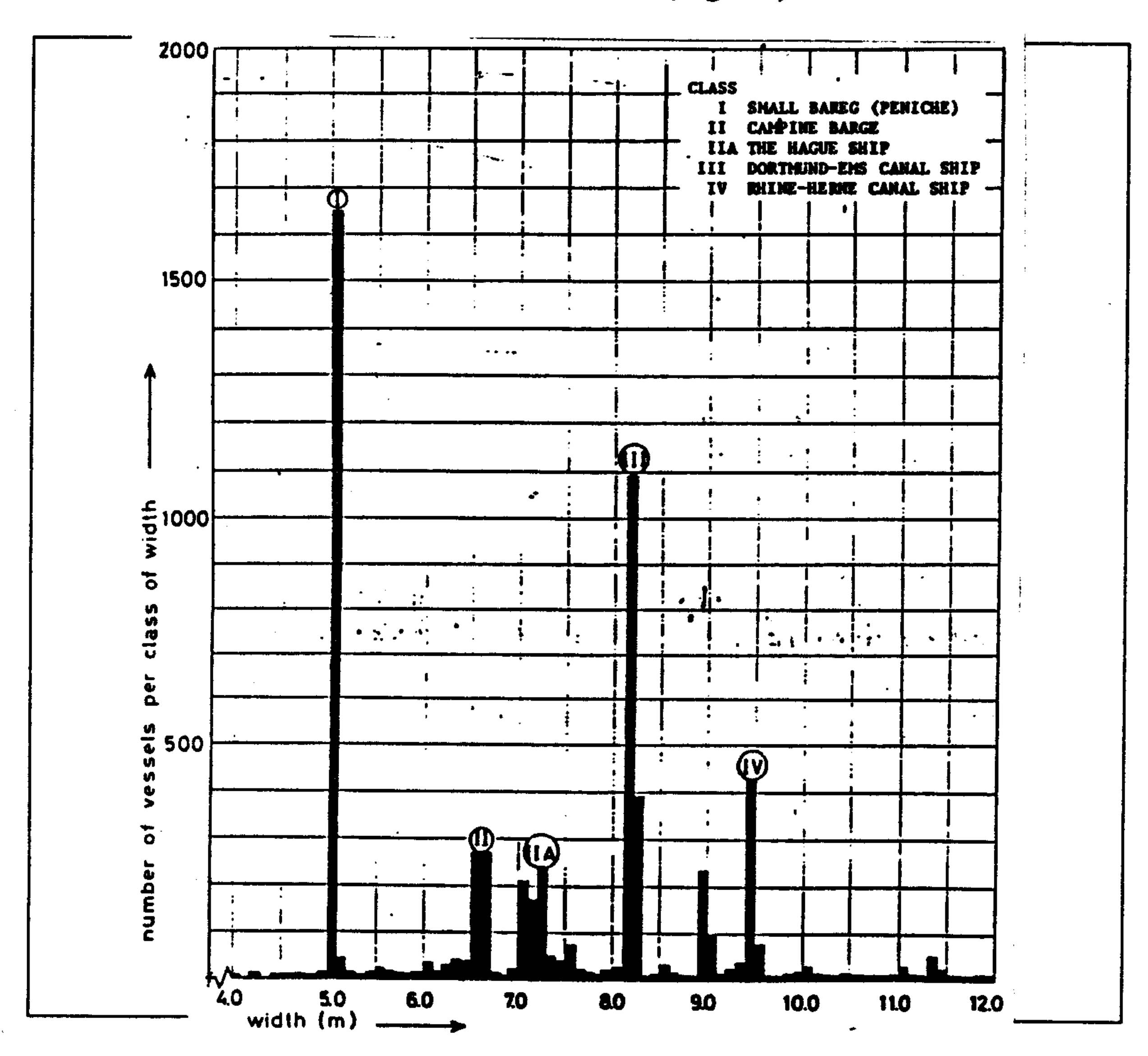


Fig 9: Width of Inland Waterway Vessels (Built after 1945)

It was therefore decided as follows:

For the classification of waterways the ECMT standard dimensions will continue to be the yardstick in the future. The existing ECMT classification system, which is also used in Germany and Belgium, has been retained, then.

The design of waterway improvements and construction of locks and bridges will be based on current vessel dimensions, and admittance policy will be brought into line with them gradually.

- Figure 10 shows the lengths of current vessels; the lengths of the design ships have been based on the predominant lengths in each class as shown in the figure.

- The height exceeded by 10% of unloaded vessels in a particular beam category has been taken as the design clearance Height (H).

- The draught reached by 50% of vessels in a particular beam category when fully laden has been taken as the design draught (T).

The standard dimensions for classification recommended by the ECMT, and the dimensions of the design ship, which are to be used from now on as the yardstick for the design of waterways and engineering structures in the Netherlands.

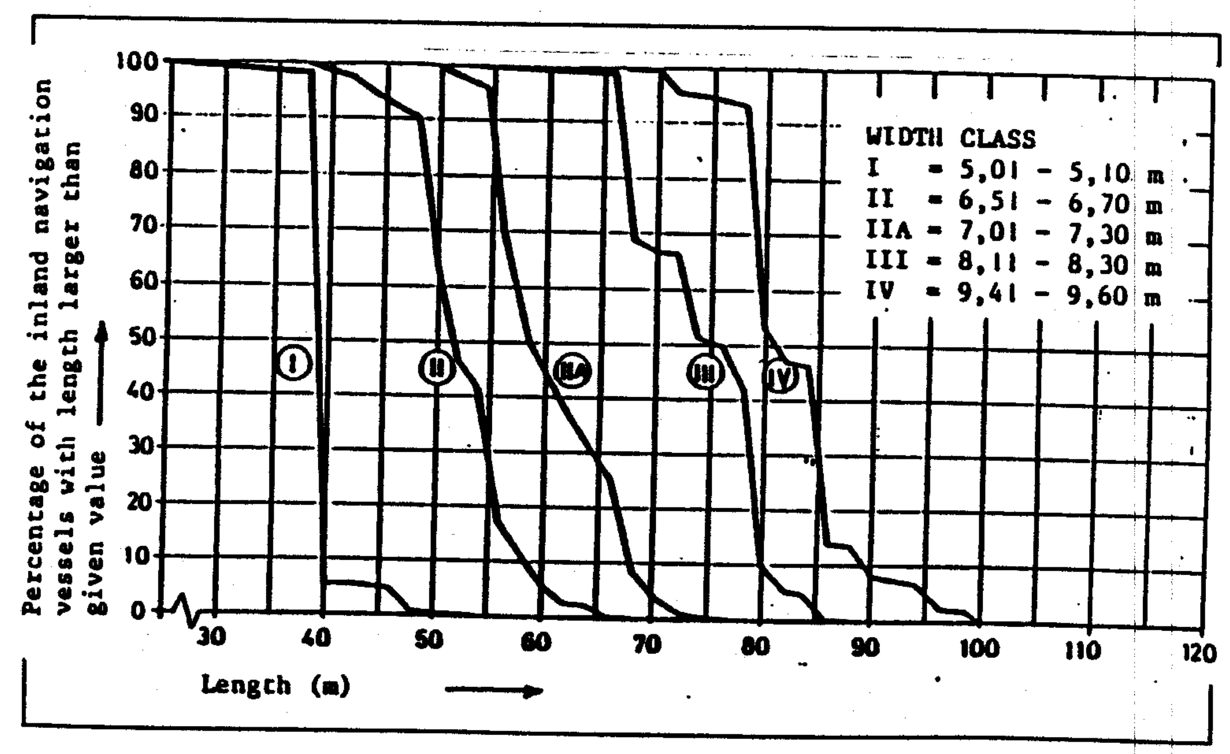


Fig. 10 EXCEDANCE FREQUENCY OF LENGTH OF INLAND WATERWAY VESSELS (BUILT AFTER 1945)

5.3 Guidelines for the safe navigation

5.3.1 CROSS-SECTION DIMENSIONS

The guidelines set out three variants for three different levels of traffic density:

1. Normal cross-section

In this cross-section two laden design ships are able to meet at speed, and a laden design ship can be overtaken with caution by another such vessel. This cross-section is used where traffic density is high (15.00 passages a year or over and, wherever possible, on new waterways. It should be seen as the optimum from the navigational point of view.

2. Narrow cross-section

In this cross-section two laden design ships are able to meet with caution, and an unladen design ship can overtake a laden design ship with caution. This cross-section is used where traffic density approximates 5.000 passages a year and in special circumstances.

3. One-way traffic cross-section

A loaded design ship is to pass through this cross-section in only one direction. It is used on short waterways with a low traffic density (approx. 1.000 Passages a year) and in special circumstances .

Cross-section may be expected to satisfy four requirements:

- The waterway must be deep enough to prevent vessels being difficult to steer or even running aground.

The waterway must be sufficiently wide to enable the standard traffic flow to pass safely.

5.3.2 CALCULATION OF TRAFFIC DENSITY TO SEVERAL TYPES OF VESSELS

The suggested width of a channel can be 150 meters for the normal cross section, 100 meter for narrow cross-section , and 50 meter can be to one way traffic cross-section.

By using the following formula, which is:.

$$Nv = \frac{wa}{wst + sm}$$

wa = average of working width.
wst = vessels width of type.
sm = safety margin, which is equal to 1.5 wider vessels beam information
Nv = number of vessels.

5.3.3 THE RIVER GUIDANCE SYSTEM

The element of river guidance system is divided mainly into following items (see the sings and signals on inland waterways).

1- Buoys system.

- Leading marks
- Warning marks
- Directional marks.

2- Land marks system

- Transit mark
- Locks mark
- Distance mark

5.3.4 PUBLICATION SHOULD BE ISSUED FOR SAFE NAVIGATION

The publication for river pilots can be issued monthly by reporting river Authority under the title of NORICES TO RIVER PILOTS.

That publication should be divided mainly into main chapters with index explaining the contents such as :

- First chapter	The depth of water
- Second chapter	The river casualty
- Third chapter	The navigational aids
- Fourth chapter	The chart corrections
- Fifth chapter	For another information

5.3.5 RECURRENT DREDGING

With the necessity of only small investment costs at the stage of improvement of an inland waterway system, recurrent dredging often is a good solution.

The last available depth in a river is at a " crossing ", where the talweg changes from riverbank.

Streamlines diverge due to a large width and consequently a shallow depth results.

The dimension of a crossing determine which least available depth will be present and how this depth changes with varying water levels in the time.

Recurrent dredging of the worst crossing in a river can increase the least available depth in this river.

Through knowledge of the behaviour of the crossings in the crossing after dredging.

Only then can a dredging program be established which can guarantee a certain minimum depth during the year.

5.3.6 THE CALCULATIONS OF SQUAT

According to the calculations of squat /22, pp. 197 - 207 / in channels , the following formula is given by:

$$\Delta T = 3.75\, CB \left(\frac{1}{\frac{bh}{BT} - 1} \right)^{3/4} \left(\frac{V}{V_o} \right)^{1/12} \frac{V^2}{2g}$$

ΔT	-	Changing of trim in meter
CB	-	Block coefficient
B	-	Channel width in meter
H	-	Depth of water in meter
B	-	Width of a ship in meter
T	-	Mean draught in meter
V	-	Speed of a ship in km/h
Vo	-	Speed of stream in km/h
g	-	Gravity

The computer calculations for the selected in river Nile (see figure 4.2) to the three types of river units (see appendix 2) gave good estimations for squat. Estimations of squat can be taken into consideration when calculating the speed of the three types of river units and the depth of water, which is valid.

The results of calculations re demonstrated in figure 4.3 the following results are discussed in relation to the given river situation.

The data, which were fed into the computer, gave the following indication:

All types of units trimmed by bow. The results given by Cairo university research center, 1989.

In the first phase in the graphs (figure 4.3) the increase in speed squat increased too.

The range of higher speed this effect are changing the trim was not in the following calculations squat will be considered in evaluations of risks.

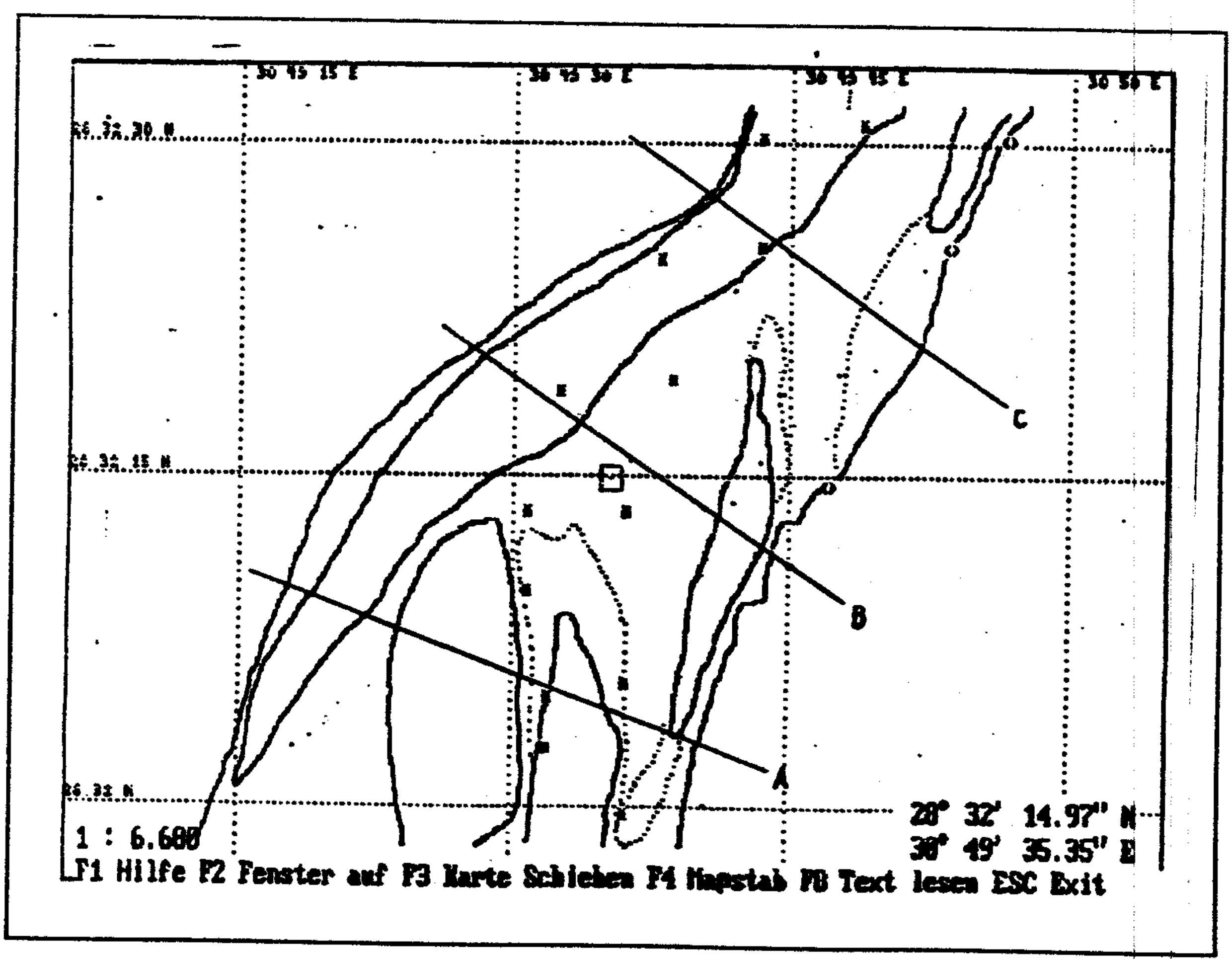


Fig. 11 The Selected Area For Squat Calculation.

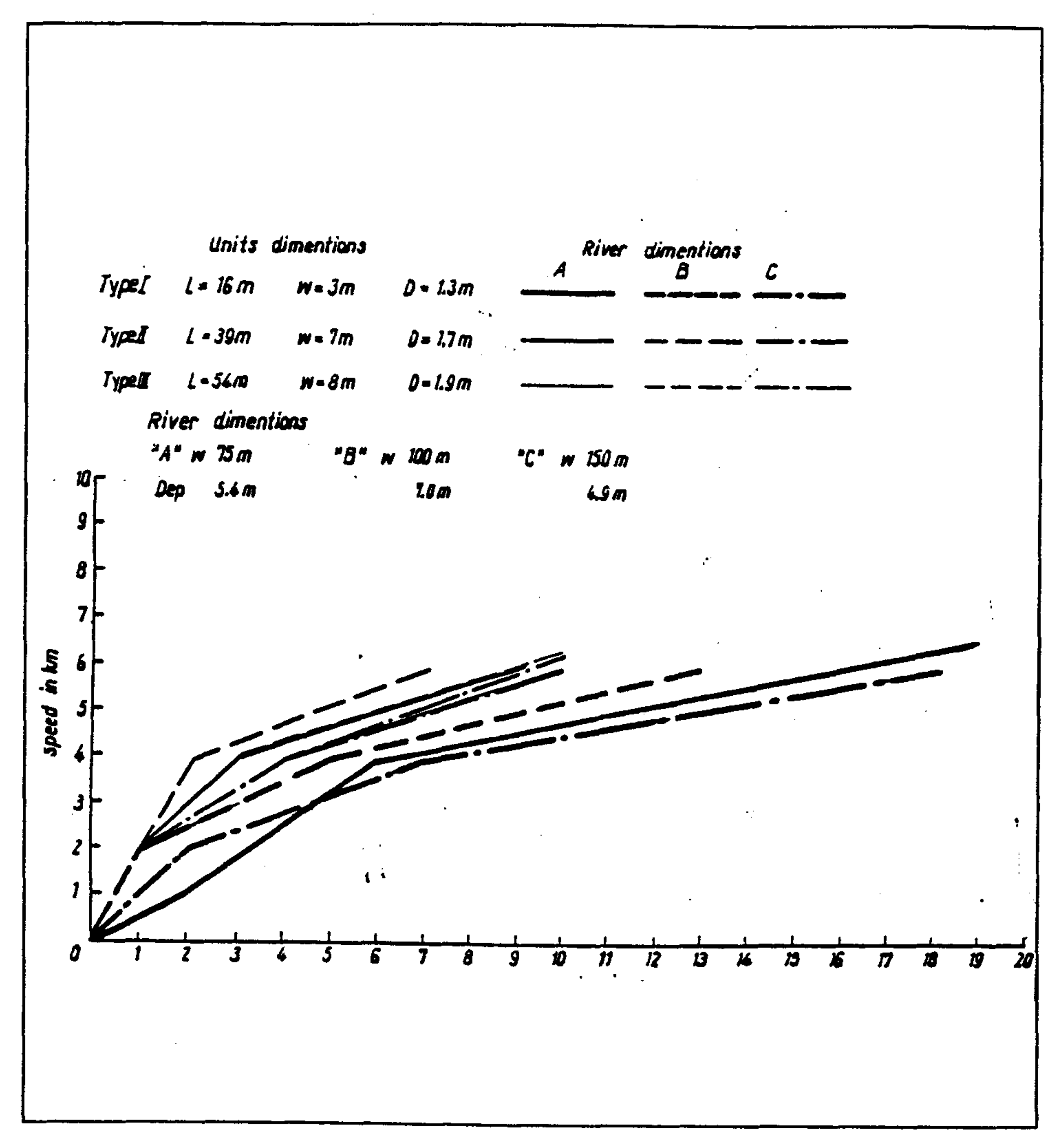


Fig. 12 Squat Results.

CHAPTER 6

6.1 Inland Waterways

6.1.1 INTRODUCTION

The inland waterway network consists of a set of navigation lines serving the ports on their routes and the land crossed by them. These navigation lines pass through the natural water channels (the Nile, Aswan high dam lake , Manzala lake , etc.) and through man mad canals (El Beheiri canal , El- Tawfiki canal , Noubaria canal , etc.) primarily built to provide the land located away from the river Nile banks with sweet water for irrigation and human needs . A series of barrages have been built in the last two centuries on the river Nile to enable the level of water to be raised to feed the canals branching south of the barrages. These barrages from barriers for inland navigation on the river Nile and on the canals, and normally are provided with waterway locks to enable waterway vessels to change their levels on both sides of the barrage . To connect the east side with the west side banks of the river Nile, and also to cross the numerous canals built all-over the country, many bridges have been built across the river Nile and the canals, forming sometimes, when built not elevated, another important navigation barrier during their closure to waterway traffic.

In section 6.1, the inland waterway system will be described in the framework of the first part of the present study, i.e. in the framework of " The study of the Egyptian inter city Transportation system ". In section 6.1.2 the present inland waterway network will be described, while the inland waterway fleets owned by the public as well as the private sector will be presented in section 6.1.3. Expenditure on inland waterways on maintenance as well as investment will be presented in section 6.1.4.

6.1.2 INLAND WATERWAY NETWORK

The General Authority for River Transport (RTA) classifies the waterways into the following classes:

a. First class waterways, these are the waterways having locks which permit the navigation of two unit trains at a time, each having a net loading up to 920 ton, a width of 7.5 m, length of 90 to 100 m , and a

draft of 1.50 up till 1.80 m when fully loaded. These waterways have locks with dimensions not less than 100 by 16 m and most of the bridges across them are of the elevated type. The total length of the first class waterways is 1,500 km.

b. Second class waterways, these are the waterways which branch from first class waterways, and having locks which permit the navigation of single units with a net loading capacity of 50 up till 150 ton, or single mechanical units with lengths of 30 up till 50 m, and breadth of 6 and 7.5 m. Total length of these waterways is 1.850 km.

c. Third class waterways; these are all other navigable waterways, which branch from second class waterways, and having operating characteristics equal to or less than the second class waterways. Total length of these waterways is 350 km.

RTA divides the navigable inland network into a series of navigable lines, each passes through defined canals or parts of the river Nile. Table 6.1.1 presents a general description of these navigable lines. Each navigable line consists of a series of reaches, which are called Hibses. Normally the reach (hibs) is bound on its both ends by two barrages with their locks. Water level at the start and end of the reach varies according to water discharge required for irrigation purposes and is defined by the Ministry of Irrigation.

As it is clear from Table 6.1.1, the inland waterway network contains 82 reaches, which form 36 navigable lines according to the definition of RTA.

Table 6.1.1 shows also the numbers of bridges, locks and ports on each navigable line, as well as their totals in the whole network.

For the purpose of network building each reach will be divided into a series of successive links, whose total length equals the length of the reach. The link has an in-node and an out-node, and has constant physical and operational characteristics over its entire length. Parameters representing these physical and operational characteristics are the length of the link, water levels, depth of the waterway (permissible draft) , breadth of the waterway section , and permissible vessels speed . The link could include elevated bridges within it as long as they do not hinder navigation. If the bridge is of the moving type, an in-node and out-node must represent it, i.e. by an individual link, to consider the delay encountered when crossing the bridge. Also locks are represented by individual links. In this way, the link

could be considered as the basic element of the network model required for traffic assignment purposes.

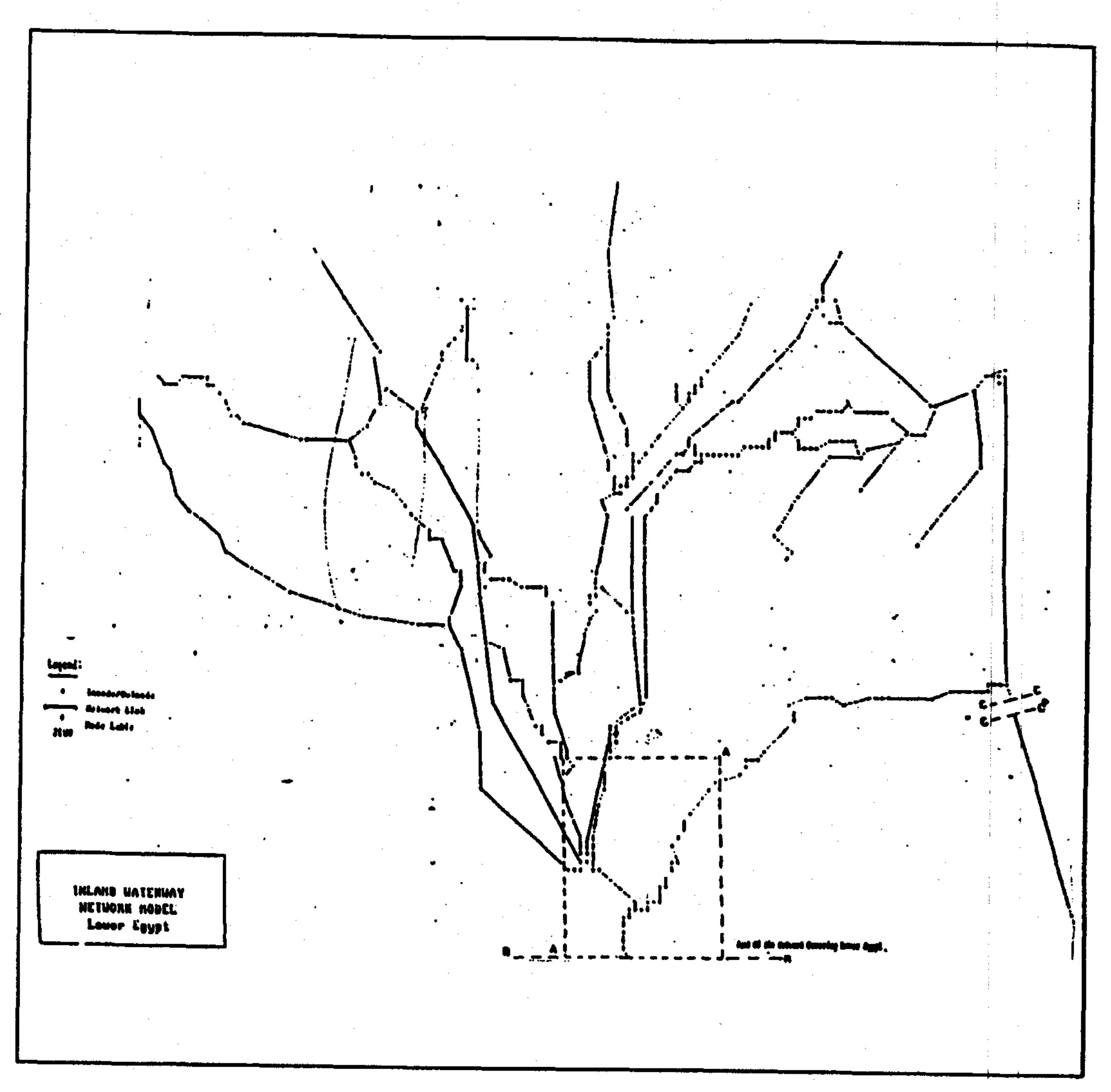


Fig. 13 Inland Waterway Network Model (1)

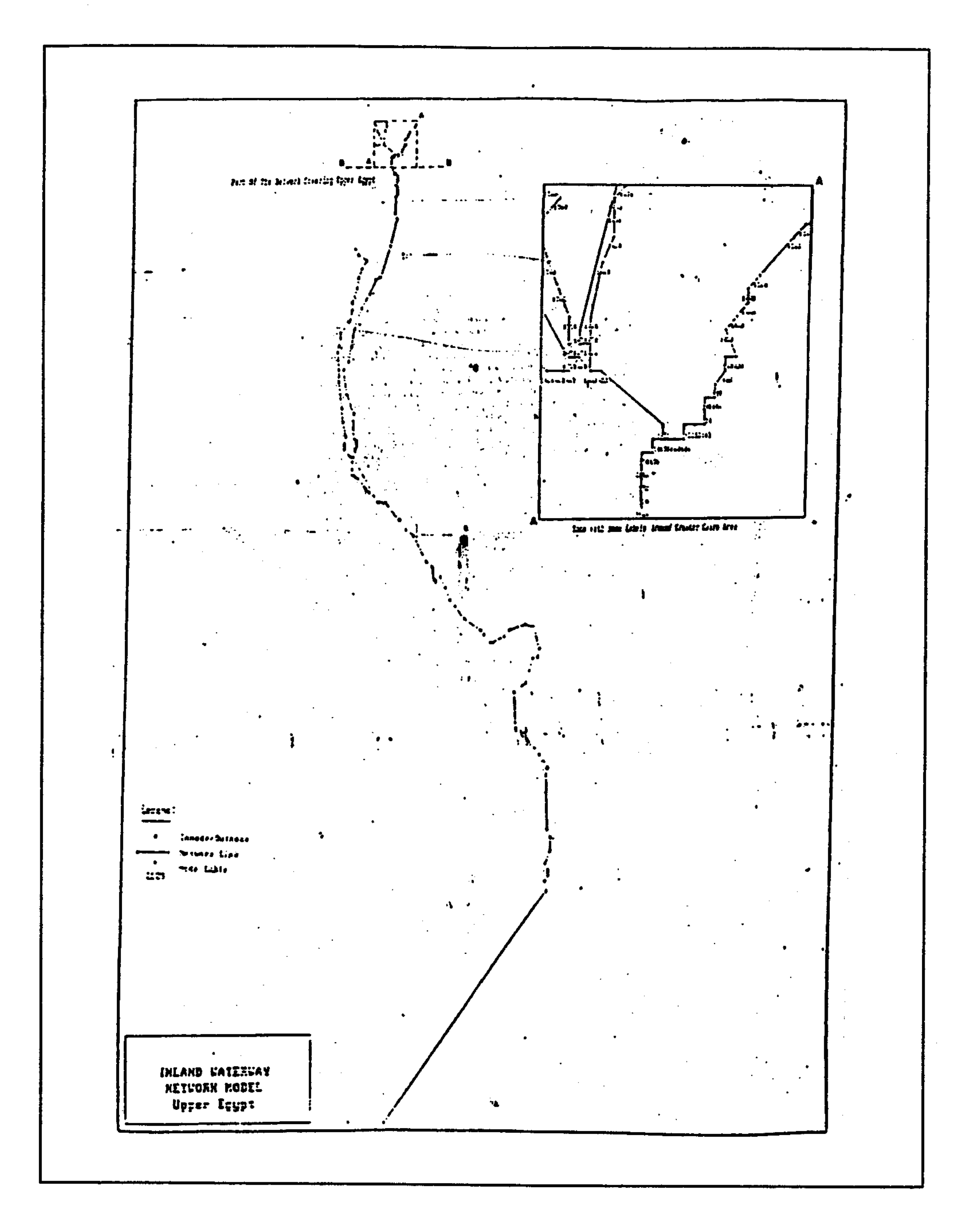


Fig. 14 Inland Waterway Network Model (2)

Table 6.1.1 RBA Navigation Lines

Code	Navigation Line Name	Canals Names On The Navigation Line	Nibs	Links	Bridge Fixed	Bridge Moving	Locks	Ports
1100	Aswan/Cairo	Nile River	5	99	11	4	3	52
1200	High Dam/Wadi Halfa	High Dam Lake	0	1	0	0	0	10
1300	Asyout/Dairout/Mallawi	Ibrahimia Canal	2	39	3	14	2	0
1301	Dairout Drain To Nile	Dairut Drain	1	4	0	1	1	0
1400	Dairout/El Fayoum	Bahr Youssef	6	44	5	13	6	0
2100	Qanater El Delta/Alexandria.	Rayah Behiri-Noubaria Canal	7	44	20	1	7	6
2120	Cairo/Abu Zabaal/Ismailiya	Ismailia Canal	3	72	21	13	8	2
2200	Kafr Boulin/Damanhour/Alexandria	EL Raya EL Behiri-ElKhandak -Can.-El Mahmoudia Can.	4	61	5	9	5	3
2300	Qanater El Delta/El Dalgamon/Zawiet Ghazal	Ray.Mounoufi-Bagouria Can.- -Rashid Bran./Mahmoudia Can.	6	67	4	21	6	0
2400	Fom El Bagouria/Tanta/El Dalgamon	Ray.Mounoufi-Bahr Shibeen- -Bagouria Can.-El Mahmoudia	3	39	1	14	4	0
2501	Desouk/El Zainy Lock	Bahr EL Saaedy	3	18	0	5	4	0
2502	Drain Num.9	Drain NO. 9	1	4	1	1	0	0
2503	Bahr Neshert Drain	Bahr Neshert Drain	1	5	0	2	0	0
2510	Qanater El Delta/Kafr El Zayat/El Qadaba	Rashid Branch	2	10	1	2	2	0
2520	El Atef/Edfina/Rashid	Rashid Branch	2	7	0	1	1	0
2600	Meleeg/El Santa/El Mahala/Semera	Rayah Mounoufi-Shibeen Bahr	3	51	3	18	3	0
2601	Damiatta Branch/Bahr Shebeen	EL Rayah EL Abasi	1	4	0	1	1	0
2602	Bahr El Maleh	Bahr EL Malah	1	8	0	3	1	0
2603	Bahr Tiyra	Bher Tiyra	2	23	0	9	3	0
2604	Semera/Belqas	Rayah Belqas	1	8	0	3	1	0
2605	Bahr Basendilah	Bahr Basendial	2	26	1	10	3	0
2606	Main Gharbiya Drain	Main Gharbiya Drain	1	19	0	7	1	0
2700	El Mansoura/Farashour/Damiatta/Medit. Sea	Damietta Branch	4	39	2	9	3	0
2800	Cairo/Benha/Meet Ghamr/Mansoura	Rayah Tawfik Mansouria Can.	4	79	3	31	4	0
2900	Mansoura/Dekernes/Manzala City	EL Bahr EL Saaghir	3	68	1	29	4	0
2901	Omoum EL Beheira Drain	Bahr EL Saghir/Bahr Hadous	2	22	0	9	2	0
2902	Bahr Saft Drain From San EL Hagr	Bahr Saft Drain	1	1	0	0	0	0
2903	EL Canal EL Melahy TO EL Manzala	EL Canal EL Melahy	1	1	0	0	0	0
2101	Kolongiel/EL Bahr EL Saaghir	Kolongiel Conn.	1	5	0	1	1	0
2102	EL Ananiya/EL Manzala Canal	EL Ananiya Canal	2	8	0	2	1	0
2111	Port Said/Ismailiya/Suez	Suez Canal	2	2	0	0	0	0
2112	Suez Canal/EL Manzala Canal	EL Fapouty Canal (EL Raswa)	1	4	3	0	0	0
2121	EL Matariya(Dakahlia)/Port Said	EL Manzala Canal	1	4	0	0	0	0
2122	Damietta/EL Matariya(Dakahlia)	EL Manzala Canal	1	2	0	0	0	0
2123	EL-Manzala Canal/Bahr EL Baqar Drain	Bahr EL Baqar Drain	1	4	0	1	0	0
2124	EL Manzala Canal/Bahr Hadous Drain	Bahr Hadous Drain	1	17	0	6	0	0
3[illegible]	TOTAL		82	909	85	240	77	63

Based on the information collected from RTA, and using the Database Computer Application for Inland Waterways developed in the Transport Sector Information System Project now in run at TPA , the study team input the basic data needed for the analysis of the waterway network on strategic planning level . The unified coding system for the networks modal nodes have been adopted for inputting the waterway link data .Table 6.1.2 shows a part of the "WREF COD " file which defines the code numbers and names of the nodes and their X&Y coordinates . The condition "zero" and "one " in the third column of this table defines whether the node represents a modal

network node and in the same time a transport zone centroid or represents a network modal node only. The whole waterway networks and is available in the computerized working files of the project. The waterway network consists of 909 links, from which 240 represent moving bridges and 77 represent locks, mainly on navigation lines of class two and three.

Table 6.1.2 sample of waterway nodes according to the Transport Information system codes

Node Code	Node Name	Cond.	X		Y		Coordinate	
			Deg	Min	Deg	Min	X	Y
30200	Alex. P.	0	29	56	31	11	596	671
30300	P. Said	0	32	14	31	16	734	676
31102	Damietta	0	31	47	31	25	707	685
31103	Faraslour	0	31	41	31	20	701	680
31201	Mect Ghamr	0	31	16	30	43	676	643
31202	Aga	0	31	16	30	56	676	656
30131	Tibeen P.	1	31	16	29	46	676	586
30134	Marazeek B.	1	31	16	29	49	676	589
30136	Mostorod M.B.(1)	1	31	19	30	9	679	609
30153	Shubra Rail B.	1	31	17	30	7	677	607
30154	Fom Ism. Canal.(1)	1	31	13	30	6	673	606
30158	Tibeen Steel P.	1	31	15	29	45	675	585
30159	Tibeen Cock P.	1	31	16	29	47	676	587
32770	Qena Petrol P.	1	32	38	26	11	758	371
32771	Nga Hammadi Alum. P.	1	32	18	26	2	738	362
32772	Nga Hammadi M.B.(1)	1	32	16	26	2	736	362
32773	Nga Hammadi M.B.(2)	1	32	16	26	2	736	362
32774	Nga Hammadi Sug.P.	1	32	12	26	6	732	366
32775	Nga Hammadi L.(1)	1	32	10	26	8	730	368
32776	Nga Hammadi L.(2)	1	32	10	26	8	730	368
32839	Wadi Halfa	1	31	14	21	59	674	119
32844	High Dam	1	32	53	23	57	773	237
32850	Khazaan Aswan	1	32	52	24	2	772	242
32851	Kima P.	1	32	54	24	7	774	247
32852	Aswan Petrol P.	1	32	54	24	8	774	248
32856	Idfu B.	1	32	53	24	59	773	299
32857	Idfu F-Silicon P.	1	32	53	25	0	773	300
32858	EL Sibiya P.	1	32	40	25	13	760	313

Based on the input data, several reports for strategic planning purposes could be produced by the application database program mentioned above. These reports could be produced on the level of a link, a reach (hibs), a navigation line , or the whole network. Table 6.1.3 illustrates a sample of the waterway link planning information presented in the LINKFILE report on the level of the whole network.

The information found in this file, together with the information about X&Y for each node from the WREF-COD file have been used to produce the inland waterway network model. Fig. 6.1.1 illustrates a graphical illustration of this model. This network model will be used later in modal network analysis and traffic assignment.

Table 6.1.3 sample of waterway link information from the " LINKFILE "

Link Code	Innode Code	Outnode Code	Innode Name	Outnode Name	Link type	Innode Kilometrage	Link Length
110001	32850	32804	Khazaan Aswan	Aswan P.	1st Class	0.00	7.00
110002	32804	32851	Aswan P.	Kima P.	1st Class	7.00	2.00
110003	32851	32852	Kima P.	Aswan Petrol P.	1st Class	9.00	3.00
110004	32852	32862	Aswan Petrol P.	EL aqaba P.	1st Class	12.00	5.00
110005	32862	32853	EL aqaba P.	Aswan Clay P.	1st Class	17.00	10.00
110006	32853	32854	Aswan Clay P.	Kabire P.	1st Class	27.00	15.00
110007	32854	32855	Kabira P.	Kom Ombo P.	1st Class	42.00	7.00
130001	32551	32556	Asyut L.(1)	Fom Ibrahimia.Canal L.	Lock	0.00	0.30
130002	32556	32557	Fom Ibrahimia.Canal	Asyut F. B.	2nd Class	0.30	0.01
130003	32557	32558	ASYUT F. B.	Asyut N. Rail B.(1)	2nd Class	0.31	1.00
130004	32558	32559	Asyut N. Rail B.(1)	ASYUT N. RAIL B.(2)	Mov.Brid.	1.31	0.04
130005	32559	32560	Asyut N. Rail B.(2)	Asyut King Faisal B.	2nd Class	1.34	0.25
130006	32560	32561	Asyut King Faisal B.	Asyut Cement Com. B.	2nd Class	1.59	6.00
290001	31299	32064	Bahr EL Saaghir L.1	Bahr EL Saaghir L.2	Lock	0.00	0.30
290002	32064	32065	Bahr EL Saaghir L.2	Meet Mazaah M.B.(1)	2nd Class	0.30	1.15
290003	32065	32066	Meet Mazaah M.B.(1)	Meet Mazaah M.B.(2)	Mov.Brid.	1.45	0.04
290004	32066	32067	Meet Mazaah M.B.(2)	Shaha M.B.(1)	2nd Class	1.49	4.31
290005	32067	32068	Shaha M.B.(1)	Shaha M.B.(2)	Mov.Brid.	5.80	0.04
290006	32068	32069	Shaha M.B.(2)	MEHALET DEMNA M.B.1	2nd Class	5.84	1.66
290007	32069	32070	Mehalet Demna M.B.1	Mehalet Demna M.B.2	Mov.Brid.	7.50	0.04
290008	32070	32071	Mehalet Demna M.B.2	Kakr A. Moemin M.B.1	2nd Class	7.54	1.46
290009	32071	32072	Kakr A. Moemin M.B.1	Kafr A. Moemin M.B.2	Mov.Brid.	8.00	0.04
290010	32072	32073	KAFR A. MOEMIN M.B.2	Geziret Qebaab M.B.1	2nd Class	8.04	0.96
290101	31374	31375	EL Masab/Bahr Nadous	1st M.B.(1)	3rd Class	0.00	5.00
290102	31375	31376	1st M.B.(1)	1st M.B.(2)	Mov.Brid.	5.00	0.04
290103	31376	31377	1st M.B.(2)	L. OF Drain(1)	3rd Class	5.04	0.46
290104	31377	31378	L. OF Drain(1)	L. OF Drain(2)	Lock	5.50	0.30
290105	31378	31379	L. OF Drain(2)	2nd M.B.(1)	3rd Class	5.80	5.70
290106	31379	31380	2nd M.B.(1)	2nd M.B.(2)	Mov.Brid.	11.50	0.04
290107	31380	31381	2nd M.B.(2)	3rd M.B.(1)	3rd Class	11.54	1.46
290108	31381	31382	3rd M.B.(1)	3rd M.B.(2)	Mov.Brid.	13.00	0.04
290109	31382	31383	3rd M.B.(2)	4th M.B.(1)	3rd Class	13.04	1.46
290110	31383	31384	4th M.B.(1)	4th M.B.(2)	Mov.Brid.	14.50	0.04

As the locks and moving bridges represent navigation barriers and affects the capacity and the journey speeds on the navigation lines, two other important reports have been produced. The first is the LOCKFILE report which contains the names of the locks, the kilometric position from the

beginning of the navigation line, whether the lock has a single or double basin, and the important dimension of the basins of the lock which affects its throughput capacity together with the water levels at the entrance and exit of the lock. Table 6.1.4 contains a sample of the information found in the LOCKFILE. The second report is the BRDGFILE, and it contains the position of the moving bridges on each navigation line together with the dimensions of the vents on both sides of the central pier. Table 6.1.5 contains a sample of the information found in the BRDGFILE.

Table 6.1.4 Sample of the Information about Locks

Line Code	Lock Code	Lock Name	Lock K.Metrage From Beginning Of Waterway	Lock Basin Number	Lock Dimension			
					Length (m)	Width (m)	Base Level	Sill Level
1100	1	Esna	169.00	(1)	80.00	16.00	0.00	0.00
1100	2	Nga Hammadi	359.04	(1)	80.00	16.00	0.00	0.00
1100	3	Asyut	546.04	(1)	80.00	16.00	0.00	0.00
1300	1	Fom El. Ibrahimia Canal	0.00	(1)	50.00	9.00	0.00	0.00
1300	2	Dairout	45.54	(1)	35.00	8.50	0.00	0.00
			0.00	(2)	55.00	9.00	0.00	0.00
2100	1	Fom EL Riah EL Beheri	0.40	(1)	116.00	16.00	0.00	0.00
2100	2	EL Khatatba	43.30	(1)	116.00	16.00	0.00	0.00
2100	3	Fom EL Noubaria	84.00	(1)	116.00	16.00	0.00	0.00
2100	4	EL Boustan	112.50	(1)	116.00	16.00	0.00	0.00
2100	5	Janaklees	145.30	(1)	116.00	16.00	0.00	0.00
2100	6	EL Nahdaa	184.30	(1)	116.00	16.00	0.00	0.00
2100	7	ALexandria Port	204.15	(1)	116.00	16.00	0.00	0.00
			0.00	(2)	55.00	16.00	0.00	0.00
2200	1	Kafr Boulin	0.00	(1)	55.00	12.00	0.00	0.00

Table 6.1.5 Sample of Movable Bridges Data

Bridge Code	Line Code	BridgeName	Bridge K.M. From Beginning Of Waterway	Width of Vent (1)	Width of Vent (2)
4	1100	Nag Hammadi	340.00	28.00	28.00
5	1100	Sohag	445.04	20.00	20.00
11	1100	El Gglla	966.44	20.00	20.00
14	1100	Imbaba	969.98	21.00	21.00
2	1300	Asyut Rail Way	1.31	10.50	10.50
5	1300	Manqbad	7.84	9.00	9.00
6	1300	Bani Hussein	14.88	9.00	9.00
7	1300	El Hawatka	22.92	9.00	9.00
8	1300	New Manfalut	26.96	9.00	9.00
9	1300	Old Manfalut	27.50	9.00	9.00
10	1300	Bani Quarrah	29.24	9.00	9.00
11	1300	Nazaaly	36.08	9.00	9.00

6.1.3 INLAND WATERWAY FLEET

By law, RTA is the governmental agency authorized to permit running licenses of mechanical boats on the inland waterway network. Sailing boats are licensed from relevant governorates, within which they normally operate, and are normally not considered in inter city transport , as they are used mainly for short distance transport of sand and gravel transport . Table 6.1.6 gives the total inland waterway fleets available in Egypt according to the statistics of RTA. The two government owned companies in the field of waterway transport owe the largest part of the inland waterway mechanical fleet .As it is clear from Table 6.1.6, the Nahri Transport Company owns 171 train units, while the Maaii Transport Company owns 124 train units. A train unit consists of two vessels; a pushed vessel and a pusher barge, and a train unit can carry a net load up to 920 ton when operated to its maximum draft. The Nahri company owes also 98 self-propelled units while the Maaii owes 124 units .In addition to these two transport companies, the Sugar Company owns 199 medium size self-propelled units for their own transport needs of sugar and molasses from upper Egypt to Cairo and Alexandria.

Table 6.1.6 Inland Waterway Fleets Owned by Public and Private Sectors

Company Name Specification	No. Of Units	Type	Cargo Handling Type	Length (m)	Width (m)	Height (m)	Draft (m)	Dead Weight Tonne (Pushed)	Dead Weight Tonne (Pusher)	Power (HP)
(1)Nahri Transport Com.										
(1-a)Nahri Fleet	35	Fleet	Bulk-Liqued	45	8	2.20	1.80	115	125	306
(1-b)German Fleet	36	Fleet	Bulk-Liqued	50	7	2.20	1.80	125	135	420
(1-c)Hungarian Fleet	28	Fleet	Bulk-Liqued	51	8	2.20	1.80	125	135	420
(1-d)Nahda Fleet	26	Fleet	Bulk	45	8	2.20	1.60	115	125	278
(1-e)Obur Fleet	15	Fleet	Bulk	51	7	2.25	1.60	125	135	342
(1-f)Salam Fleet	31	Fleet	Bulk	50	7	2.25	-	125	135	375
(1-g)Mechanical Barges	98	Self Motion	Bulk-Liqued	-	-	-	-	-	110	175
(1-h)Tractors	49	Tractor	Bulk-Liqued	-	-	-	-	-		-
(2)Maaii Trasnport Com.										
(2-a)Maaii Fleet	25	Fleet	Bulk	43	8	2.10	1.70	105	115	350
(2-b)Kafat Fleet	28	Fleet	Bulk	46	8	2.10	1.80	105	115	330
(2-c)Romanian Fleet	40	Fleet	Bulk	45	7	2.50	1.60	110	120	460
(2-d)Tersana Fleet	30	Fleet	Bulk	50	7	2.50	1.60	125	135	480
(2-e)Salam Fleet	1	Fleet	Bulk-Liqued	51	7	2.50	1.80	125	135	375
(2-f)Mechanical Barges	129	Self Motion	Bulk-Liqued	-	-	-	-	-	110	175
(2-g)Tractors	22	Tractor	-	-	-	-	-	-	-	-
(3)Sugar Com.										
(3-a)Mechnical Barges	199	Self Motion	Bulk-Liqued	41	7	2.10	15.00	-	-	180
(3-b)Tractors.	25	Tractor	-	-	-	-	-	-	-	-
(4)Private Sector										
(4-a)Mechanical Barges	700	Mechanical	Bulk-Liqued	37	6	2.00	1.30	-	-	200
(6)Tourism Boats	262	-	-	57	10	7.00	1.50	-	-	450

Source:RTA Statistics, July 1992

The private sector owns a fleet of 700 units; most of them are of the medium sized self-propelled units.

Cruising over the river Nile is playing a bigger role in the last decade. In the late 1970's, there are only a dozen of tourist cruising boats running between Luxor and Aswan, compared to 262 cruising boats, most of them 5-stars, are operated successfully in 1992 between Cairo and Aswan.

6.1.4 EXPENDITURE ON INLAND WATERWAY INFRASTRUCTURE

RTA is the governmental agency responsible for maintenance, upgrading and development of inland waterways in Egypt. The budget of RTA in the year 1990/1991 was LE 8,011,719, from which LE 1,673,779 were allocated for salaries and consumables for RTA governmental staff in the central administration and districts. An investment of LE 6,327,940 was allocated for structural maintenance and development projects.

Actual investment expenditure in the same year by project was as follows:

Table 6.1.7 RTA Investment by Project

Name of Project	Actual Expenditure (LE)
a. Constrction of Admin. Buildings	455,999
b. Construction of Cargo Handling Terminals	453,719
c. Development of the Navigation Line Cairo/Aswan	1,035,199
d. Development of the Navigation Line Beheri/Noubaria	2,176,266
e. Development of the Navigation Line Port Said/Mataria	146,700
f. Development o the Navigation Line Damietta Branch	256,744
g. Renewal of Vehicles and Telecommunication Aids	92,296

The current 5 - year development plan has approved a total investment of 127,5 million LE, and have been scheduled by year and project as shown in Table 6.1.8.

Table 6.1.8 RTA Investment Schedule by Project

Name of project	5-years total (1,00LE)	First Year Expenditure
a. Construction of Cargo Handling Term.	600	600
b. Develop. of Nav. Line Cairo/Aswan	4,000	1,500
c. Develop. of Nav. Line Beheri/ Noubaria	10,000	3,000
d. Develop. of Nav. Line Port Said/Matar.	1,000	400
e. Develop. of Damietta Branch .	108,950	—
f. Renewal of Vehicles and Telcomm. Aids	2,950	500

The average annual investment expenditure is in the order of 5 millions LE, and the abnormal increase in the 5 year plan is due to the proposal of the development of the Damietta branch to transfer it from a second class to a first class navigation line.

Typical expenditure items in the year 1990/1991 was as follows

Table 6.1.9 RTA Expenditure Items in 1990/1991

Item	Quantity
(1) Dredging works	
a. Up and Down Souhag Bridge	126,000 m3
b. Up and Down Menia Bridge	2,416,500 m3
c. Salwa Region, Upper Egypt	13,000 m3
d. Navigation Line Beheri/Noubaris Canal, Dredging	397,000 m3
e. Navigation Line Beheri/Noubaris Canal, Excavation	9,200 m3
f. Navigation Line Port Said/ Mataria, Dredging	83,618 m3
(2) Embankment Protection	
a. entrance of Noubaria Lock	600 m3
b. Delivery, & installation of metallic sheet piles	214 ton
c. Reinforced Concrete Works	198 m3
(3) Lock Maintenance Works	
a. Delivery and Installation of Dock Anchorage at Ghataba Lock	
b. Development and raising the Efficiency of the Small Maleh Lock	
c. Development and raising the Efficiency of the Big Maleh Lock	
d. Fixation of a Crane on a Pontoon	
e. Development of the Noubaria Entrance Lock	
f. Repair of the Up Gate of the Ghataba Lock	
(4) Maintenance of RTA Equipment	
a. Construction and Delivery of a Tractor for RTA	
b. Development of the Service Boat Misr	
c. Repair of the Service Ship in High Aswan Lake	
(5) Studies	
a. Study of the Navigation Problems in front of Qena Bridge	
b. Study of the Navigation Problems in Qus Region	
c. Study of the Development of the Navigation on the Damietta Branch.	

RTA does not implement the above mentioned projects by its own staff, but assigns them to specialized contractors and consultants.

CHAPTER 7

7.1 MODAL SPLIT OF FREIGHT

The freight was split to the three modes of highway , railway and waterway by the following three methods to check the influence to the road transport demand by the deference of approaches.

(1) Present Share Method,

(2) Minimum Cost Method, and

(3) Pre-determined Method.

7.1.1 PRESENT SHARE METHOD

The present share of the road transport freight occupies 94% of the total freight demand in terms of ton, therefore even if the study assumed that all the commodities will be transported by road only , the estimate error of the road freight transport demand will remain within 6% level . Taking this fact into consideration, the present mode share by 29 zone base OD pair and by 30 commodities is applied to estimate the future road transport demand as the base case. The total mode share will be affected by the deference of the growth rate in each OD pair and in commodities.

Table 7.1.1 shows the results of modal split by the present mode share by commodity and by 29 based OD pair. The growth of road transport share in phosphate shows the significant increase of 180 times the present reflecting the high growth of production, however the railway is scheduled for the transportation of new developed phosphate to Safaga port, and such mass and bulk transport should be further discussed in this case. On the other hand, in the case of the other food products, the rail transport shows the high growth of 11 times the present and also the appropriate transport mode for these kind of small sized - high frequency transport demand should also be discussed.

Table 7.1.1 Future Freight Demand by Mode

(GDP 6.5% Case , Present Share Method

Commo-dity	1992 (1,000ton/year)				2012 (1,000ton/year)				2012/1992			
	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total
1 COIL	0	0	0	0	0	0	0	0	-	-	-	-
2 PETR	11,104	1,208	423	12,736	14,962	2,853	0	17,815	1.3	2.4	0.0	1.4
3 NGAS	0	0	0	0	0	0	0	0	-	-	-	-
4 CEMT	25,843	341	1,010	27,194	91,414	6,876	12,493	110,783	3.5	20.2	12.4	4.1
5 CMAT	43,662	737	160	44,558	192,277	11,170	576	204,023	4.4	15.2	3.6	4.6
6 PHOS	69	649	82	801	12,639	594	0	13,233	182.1	0.9	0.0	16.5
7 IORE	0	2,502	0	2,502	1,658	2,953	0	4,611	-	1.2	-	1.8
8 COAL	209	807	805	1,821	2,993	3,423	661	7,077	14.3	4.2	0.8	3.9
9 MNRL	4,997	46	400	5,443	13,538	31	46	13,615	2.7	0.7	0.1	2.5
10 WHET	6,551	1,351	19	7,921	14,648	2,635	0	17,283	2.2	2.0	0.0	2.2
11 CERE	5,358	93	0	5,450	12,132	240	0	12,372	2.3	2.6	-	2.3
12 FRUT	13,965	0	0	13,965	33,307	2	0	33,309	2.4	10.0	-	2.4
13 SCAN	609	8	0	617	695	210	0	905	1.1	28.0	-	1.5
14 FCRP	466	0	0	466	755	0	0	755	1.6	-	-	1.6
15 LSTK	1,462	0	0	1,462	2,338	0	0	2,338	1.6	-	-	1.6
16 APRD	2,613	5	0	2,617	4,039	8	0	4,047	1.5	1.7	-	1.5
17 AGPR	5,291	1	0	5,291	27,492	0	0	27,492	5.2	0.0	-	5.2
18 SGAR	1,540	511	253	2,303	2,032	1,073	158	3,263	1.3	2.1	0.6	1.4
19 FATS	1,049	128	0	1,178	3,739	222	0	3,961	3.6	1.7	-	3.4
20 AFED	5,681	1	0	5,682	26,462	28	0	26,490	4.7	40.0	-	4.7
21 BVRG	455	0	0	455	2,427	0	0	2,427	5.3	-	-	5.3
22 OFOD	3,563	11	0	3,574	5,559	23	0	5,582	1.6	2.1	-	1.6
23 CHEM	6,239	0	0	6,239	13,640	0	0	13,640	2.2	-	-	2.2
24 MTAL	6,587	463	36	7,086	13,896	2,376	87	16,359	2.1	5.1	2.4	2.3
25 TXTL	2,097	0	0	2,097	4,548	0	0	4,548	2.2	-	-	2.2
1 FTLZ	3,683	241	8	3,932	8,652	465	0	9,117	2.3	1.9	0.0	2.3
2 PULP	1,870	0	0	1,870	5,889	0	0	5,889	3.1	0.0	-	3.1
3 LUMB	2,249	13	0	2,262	3,915	153	0	4,068	1.7	11.8	-	1.8
4 MANU	6,545	526	2	7,073	19,506	1,403	7	20,916	3.0	2.7	3.3	3.0
5 MEXC	1,738	0	18	1,756	5,146	0	33	5,179	3.0	-	1.9	2.9
Total	165,495	9,642	3,214	178,350	540,298	36,738	14,061	591,097	3.3	3.8	4.4	3.3
Share	92.8	4.2	1.9	100.0	91.4	6.2	2.4	100.0				

7.1.2 MINIMUM COST METHOD

The minimum cost method is to pick up the minimum cost routes and mode in terms of economic cost between OD pairs and to assign all the OD pair freight to these routes. The economic transport cost is calculated based on the various factors and they normally are divided into fixed cost and variable cost portions and thus are influenced by the transport demand and distance itself. However for the estimation process of the transport demand, the cost should be fixed as the input value before starting calculation, so that the results of the Transportation Economic Study, Feb. 1991 were applied in the study, where economic costs by mode and by commodity were calculated in terms of ton-km based on the past transport records.

The following economic costs by transport mode were applied to estimate the freight by minimum cost route. In the above study, the railway cost were divided into five commodities, and for the truck and waterway, bulk cargo was assumed to be transported by 24 ton trailer or twinship and others by 8 ton truck or self propelled barges.

Table 7.1.2 Economic Cost of Various Modes

Commodity	Economic Cost (LE/1,000 ton-km)		
	Hwy	Rwy	Wwy
Petroleum Products	40.392	22.849	30.350
Construction Material	40.392	44.377	30.350
Iron Ore and Mining Prod.	40.392	30.375	30.350
Cole/Coke	40.392	35.433	30.350
Wheat and Cereals	40.392	48.035	30.350
Mixed Commodities and Others	52.375	44.377	38.710

The freight will be estimated by the linear programming (LP) to minimize the following object function under the conditions of the generation at the production zone and the attraction at the consumption zone. The freight by mode will be estimated at the same time with the estimate of distribution volume.

$\Sigma\Sigma\Sigma$ Cmi j x Pmi j

where C	:	freight cost by ton
P	:	freight volume
M	:	transport mode
i	:	generation zone
j	:	attraction zone

subject to ;

ΣPi	=	Gi
ΣPj	=	Ai
where G	:	generation volume
A	:	attraction volume

The minimum cost route by mode and by commodity was searched and the minimum cost routes and their costs for each OD pair were listed up for LP. The calculation was done by Simplex big-M tableau method. The number of variables in the object function were 841 (29 x 29), and the constraints function were 58 (2 x 29). In cases of railway or waterway, they can not transport commodities from their origin to the destination unless the origins or destinations are connected to the zone centroids, so that the transport cost includes these access costs and if the main route is either railway or waterway, then they are classified as rail transport or water transport modes.

The resulted future freight by mode was summarized in Table 7.1.3. The share of highway reduces to 87.5%, railway share will remain in the same level of 4.8%, and waterway share increases to 7.7%, which is 4 times the present.

Railway shows the advantage in terms of economic transport cost only in the seven commodities of problem products, cement, phosphate, iron ore, other minerals, fiber crops and edible oil and fats, mainly in the mining products. Especially in the case of phosphate, its share reaches to 77% of the total. Waterway shows the advantage in various commodities, especially in the case of Coal/Coke, its share reaches to 66%.

The cost of self propelled barges was assumed as the economic transport cost of general cargo in waterway adding access cost of loading and unloading, however the cost was calculated based on transport records of such bilk and high volume cargoes as wheat, coal and coke or petroleum products, therefore if the smaller barge capacity is applied to the general cargoes then the waterway operating cost in these commodities will increase and their share will decrease. Partially general cargo requires high frequency

low capacity transport, and thus the present share of general cargo shows the high inclination to the highway mode.

Table 7.1.3 Freight by Minimum Cost Mode in 2012

Commo-dity	1992 (1,000ton/year)				2012 (1,000ton/year)				2012/1992			
	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total
1 COIL	0	0	0	0	0	0	0	0	-	-	-	-
2 PETR	11,104	1,208	423	12,736	12,216	2,439	3,160	17,815	1.1	2.0	7.5	1.4
3 NGAS	0	0	0	0	0	0	0	0	-	-	-	-
4 CEMT	25,843	341	1,010	27,194	95,428	11,402	3,953	110,783	3.7	33.4	3.9	4.1
5 CMAT	43,662	737	160	44,558	192,751	0	11,272	204,023	4.4	0.0	70.4	4.6
6 PHOS	69	649	82	801	3,079	10,154	0	13,233	44.4	15.6	0.0	16.5
7 IORE	0	2,502	0	2,502	0	4,127	484	4,611	-	1.6	-	1.8
8 COAL	209	807	805	1,821	2,378	0	4,699	7,077	11.4	0.0	5.8	3.9
9 MNRL	4,997	46	400	5,443	8,992	64	4,559	13,615	1.8	1.4	11.4	2.5
10 WHET	6,551	1,351	19	7,921	16,536	0	747	17,283	2.5	0.0	39.9	2.2
11 CERE	5,356	93	0	5,450	11,628	0	744	12,372	2.2	0.0	-	2.3
12 FRUT	13.965	0	0	13,965	28,870	0	4,439	33,309	2.1	0.0	-	2.4
13 SCAN	609	8	0	617	605	0	300	905	1.0	0.0	-	1.5
14 FCRP	466	0	0	466	692	0	63	755	1.5	-	-	1.6
15 LSTK	1,462	0	0	1,462	2,129	0	209	2,338	1.5	-	-	1.6
16 APRD	2,613	5	0	2,617	3,795	0	252	4,047	1.5	0.0	-	1.5
17 AGPR	5,291	1	0	5,291	26,159	0	1,333	27,492	4.9	0.0	-	5.2
18 SGAR	1,540	511	253	2,303	2,810	0	453	3,263	1.8	0.0	1.8	1.4
19 FATS	1,049	128	0	1,178	3,690	3	268	3,961	3.5	0.0	-	3.4
20 AFED	5,681	1	0	5,682	24,620	0	1,870	26,490	4.3	0.0	-	4.7
21 BVRG	455	0	0	455	2,246	0	181	2,427	4.9	-	-	5.3
22 OFOD	3,563	11	0	3,574	5,171	6	404	5,582	1.5	0.6	-	1.6
23 CHEM	6,239	0	0	6,239	12,300	0	1,340	13,640	2.0	-	-	2.2
24 MTAL	6,587	463	36	7,086	14,521	0	1,838	16,359	2.2	0.0	51.5	2.3
25 TXTL	2,097	0	0	2,097	4,425	0	123	4,548	2.1	-	-	2.2
26 FTLZ	3,683	241	8	3,932	7,634	0	1,483	9,117	2.1	0.0	195.1	2.3
27 PULP	1,870	0	0	1,870	5,674	0	215	5,889	3.0	0.0	-	3.1
28 LUMB	2,249	13	0	2,262	3,965	0	103	4,068	1.8	0.0	-	1.8
29 MANU	6,545	526	2	7,073	19,897	0	1,019	20,916	3.0	0.0	485.2	3.0
30 MEXC	1,738	0	18	1,756	5,089	0	90	5,179	2.9	-	5.1	2.9
Total	165,495	9,642	3,214	178,350	517,300	28,195	45,601	591,097	3.1	2.9	14.2	3.3
Share	92.8	5.4	1.8	100.0	87.5	4.8	7.7	100.0				

The mode share by minimum cost method will show the future desirable mode share in terms of economic transport cast and will not give the future modal split projection. However the present share method include unexpected results by sticking to the present mode share. Therefore future modal split projection will be made by selecting from these two results commodity by commodity.

7.1.3 PRE-DETERMINED METHOD

The road transport freight occupies 94% of the total inter semi-governorate freight at present , however minimum cost method proved there are some commodities suitable for railway or waterway from the view point of economic transport cost , and in some commodities they look more realistic than the calculation results by present pattern method . However minimum cost method determines commodity distribution at the same time and the resulted distribution patterns are always idealistic. Therefore in this case, the freight calculated in the section 7.1.2 is allocated to the most economy modes in 29 OD pair base in the following 7 selected commodities.

1. Phosphate Ore
2. Iron Ore
3. Coal and Coke
4. Sugar Cane
5. Sugar
6. Edible oil and Fats
7. Fertilizer

These commodities showed 15% or more mode share in the minimum cost method and are considered more suitable for rail or waterway transport.

In ENTS-II and III, the pre-determined method was applied based on the almost same logic as above. The commodities with the specific OD pairs were allocated to the specific modes which show its economic advantage comparing with the other modes, giving some mode shares based on observed or estimated results.

Table 7.1.4 shows the results of calculation. Comparing with the results of minimum cost method, coal and coke lost its share in the waterway, because of transport of coals from Sinai to Cairo by highway. While in other

commodities railway or waterway obtained more share than those did by the minimum cost method. The total share of highway is calculated 85.3%, rail 7.7% and waterway 6.9%.

Table 7.1.4 Pre-Determined Modal Share

Commo-dity	1992 (1,000ton/year)				2012 (1,000ton/year)				2012/1992			
	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total
1 COIL	6	0	0	0	0	0	0	0	-	-	-	-
2 PETR	11,104	1,206	423	12,736	14,963	2,852	0	17,815	1.3	2.4	0.0	1.4
3 NGAS	0	0	0	0	0	0	0	0	-	-	-	-
4 CEMT	25,843	341	1,010	27,194	91,416	6,875	12,492	110,783	3.5	20.2	12.4	4.1
5 CMAT	43,662	737	160	44.558	192,277	11,170	576	204,023	4.4	15.2	3.6	4.6
6 PHOS	69	649	82	801	2,144	11,089	0	13,233	30.9	17.1	0.0	16.5
7 IORE	0	2,502	0	2,502	0	4,127	484	4,611	-	1.6	-	1.8
8 COAL	209	807	805	1,821	2,993	0	4,084	7,077	14.3	0.0	5.1	3.9
9 MNRL	4.997	46	400	5,443	2,129	60	11,427	13,616	0.4	1.3	28.6	2.5
10 WHET	6.551	1,351	19	7,921	11,491	2,557	3,235	17,283	1.8	1.9	173.0	2.2
11 CERE	5,358	93	0	5.450	12,132	240	0	12,372	2.3	2.6	-	2.3
12 FRUT	13,965	0	0	13,965	33,307	2	0	33,309	2.4	10.0	-	2.4
13 SCAN	609	8	0	617	141	0	764	905	0.2	0.0	-	1.5
14 FCRP	466	0	0	466	755	0	0	755	1.6	-	-	1.6
15 LSTK	1,462	0	0	1,462	2,338	0	0	2,338	1.6	-	-	1.6
16 APRD	2,613	5	0	2,617	4,038	9	0	4,047	1.5	2.0	-	1.5
17 AGPR	5,291	1	0	5,291	27,492	0	0	27,492	5.2	0.0	-	5.2
18 SGAR	1,540	511	253	2,303	1,082	6	2,175	3,263	0.7	0.0	8.6	1.4
19 FATS	1,049	128	0	1,178	1,870	1	2,090	3,961	1.8	0.0	-	3.4
20 AFED	5,681	1	0	5,682	26,462	28	0	26,490	4.7	40.0	-	4.7
21 BVRG	455	0	0	455	2,427	0	0	2,427	5.3	-	-	5.3
22 OFOD	3,563	11	0	3,574	5,560	22	0	5,582	1.6	2.0	-	1.6
23 CHEM	6,239	0	0	6,239	13,640	0	0	13,640	2.2	-	-	2.2
24 MTAL	6,587	463	36	7,086	11,184	5,088	87	16,359	1.7	11.0	2.4	2.3
25 TXTL	2.097	0	0	2,097	4,548	0	0	4,548	2.2	-	-	2.2
26 FTLZ	3,683	241	8	3,932	5,563	0	3,554	9,117	1.5	0.0	467.6	2.3
27 PULP	1,870	0	0	1,870	5,889	0	0	5,889	3.1	0.0	-	3.1
28 LUMB	2,249	13	0	2,262	3,916	152	0	4,068	1.7	11.7	-	1.8
29 MANU	6,545	526	2	7,073	19,512	1,396	7	20,915	3.0	2.7	3.3	3.0
30 MEXC	1,738	0	18	1,756	5,146	0	33	5,179	3.0	-	1.9	2.9
Total	165,495	9,642	3,214	178,350	504,415	45,674	41,008	591,097	3.0	4.7	12.8	3.3
Share	92.8	5.4	1.8	100.0	85.3	7.7	6.9	100.0				

7.2 Vehicle Demand Forecast

7.2.1 VEHICLE OD

Future passenger and freight OD was converted to the future vehicle OD applying the present average occupancy of passenger vehicles and by the present average loading weight By commodities. The empty trucks were assigned to the opposite direction of the commodity origin and destination. Table 7.2.1 shows the vehicle demand generation in the year 1992 and 2012 by zone. The average growth ratio of all the vehicles and all the zones is 2.73 times the 1992 level.

Table 7.2.1 Vehicle Generation Forecast (Base Case)

ZONE	GENERATION 1992 (VEH/DAY)					GENERATION 2012 (VEH/DAY)					2012/1992				
	P.CAR	TAXI	BUS	TRUCK	TOTAL	P.CAR	TAXI	BUS	TRUCK	TOTAL	P.CAR	TAXI	BUS	TRUCK	TOTAL
1 CAI	15,554	12,086	2,559	19,766	49,965	28,237	34,409	5,735	67,046	135,427	1.82	2.85	2.24	3.39	2.71
2 GIZ	2,395	2,416	756	4,756	10,323	6,731	6,961	855	12,494	27,041	2.81	2.88	1.13	2.63	2.62
3 QAL	3,232	3,561	492	4,502	11,787	10,666	8,689	1,909	10,697	31,961	3.30	2.44	3.88	2.38	2.71
4 SKS	7,588	5,269	1,186	5,885	19,928	14,108	13,147	2,101	15,241	44,597	1.86	2.50	1.77	2.59	2.24
5 SKN	2,741	2,137	480	1,503	6,861	7,213	6,950	1,079	5.134	20,376	2.63	3.25	2.25	3.42	2.97
6 DKE	6,575	4,986	1,147	5,593	18,301	14,428	13,815	2.216	13,277	43,736	2.19	2.77	1.93	2.37	2.39
7 DKW	894	819	137	1,083	2,933	6,096	6,101	1,007	3,716	16,920	6.82	7.45	7.35	3.43	5.77
8 DAM	2,978	1,796	424	3,864	9,062	8,473	8,357	1,297	7,500	25,627	2.85	4.65	3.06	1.94	2.83
9 PTS	2,218	1,453	183	2,853	6,707	3,753	2,966	778	3,286	10,783	1.69	2.04	4.25	1.15	1.61
10 ISM	2,080	1,876	226	2,624	6,806	4,688	3,584	893	5,185	14,350	2.25	1.91	3.95	1.98	2.11
11 SUZ	648	488	137	4,546	5,819	1,651	3,281	456	7,952	13,340	2.55	6.72	3.33	1.75	2.29
12 MIF	3,358	4,316	723	4,940	13,337	13,764	11,023	2,296	10,918	38,001	4.10	2.55	3.18	2.21	2.85
13 GHS	3,222	3,879	816	7,736	15,653	14,730	12,680	2,372	14,477	44,259	4.57	3.27	2.91	1.87	2.83
14 GHN	1,694	1,045	513	2,019	5,271	9,648	9,458	1,234	5,881	26,221	5.70	9.05	2.41	2.91	4.97
15 KAF	2,354	3,156	496	3,684	9,690	8,031	6,929	1,398	9,896	26,254	3.41	2.20	2.82	2.69	2.71
16 BHS	1,740	1,762	266	4,497	8,265	5,594	5,299	1,009	7,907	19,809	3.21	3.01	3.79	1.76	2.40
17 BHN	2,978	3,948	701	6,437	14,064	9,379	8,100	1,532	13,790	32,801	3.15	2.05	2.19	2.14	2.33
18 ALX	6,150	4,957	823	15,104	27,034	16,109	14,536	3,455	36,319	70,319	2.62	2.93	4.20	2.40	2.60
19 WDS	1,683	474	375	3,477	6,009	1,061	2,338	94	2,546	6,039	0.63	4.93	0.25	0.73	1.00
20 SIN	490	343	91	595	1,519	578	966	72	1,840	3,456	1.18	2.82	0.79	3.09	2.28
21 FAY	1,035	1,237	378	1,354	4,004	3,844	4,188	494	7,146	15,672	3.71	3.39	1.31	5.28	3.91
22 BES	1,202	1,426	376	998	4,002	4,497	5,269	687	3,295	13,748	3.74	3.69	1.83	3.30	3.44
23 MYA	765	1,050	254	1,073	3,142	3,318	4,792	778	5,233	14,121	4.34	4.56	3.06	4.88	4.49
24 ASY	831	1,595	180	905	3,511	2,876	3,393	692	5,183	12,144	3.46	2.13	3.84	5.73	3.46
25 NEW	13	51	12	40	116	45	120	13	979	1,157	3.46	2.35	1.08	24.48	9.97
26 SOH	690	1,424	124	695	2,933	3,366	3,397	828	5,376	12,967	4.88	2.39	6.68	7.74	4.42
27 QEN	625	1,438	178	781	3,022	3,064	5,833	998	5,426	15,321	4.90	4.06	5.61	6.95	5.07
28 ASW	113	555	50	527	1,245	774	919	274	3,154	5,121	6.85	1.66	5.48	5.98	4.11
29 RED	178	255	58	407	898	487	737	109	974	2,307	2.74	2.89	1.88	2.39	2.57
TOTAL	76,024	69,798	14,141	112,244	272,207	207,209	208,237	36,661	291,768	743,875	2.73	2.98	2.59	2.60	2.73
SHARE	27.9	25.6	5.2	41.2	100.0	27.9	28.0	4.9	39.2	100.0					

7.2.2 TRAFFIC ASSIGNMENT METHODOLOGY

1. General Methodology

Vehicles are assigned to road links by minimum route method. In the first iteration, traffic is assigned to the minimum routes with free flow speed for each of 188 OD pairs, part of OD pair traffic is assigned to the minimum routes, the speeds on links are re-calculated according to the capacity reduction formula and the minimum routes for 2nd iteration are searched, and so on. The assignment is calculated on the hourly traffic basis and then converted to the daily traffic volume with PHF of 8% in normal rural highways.

2. Passenger Car Unit (PCU)

The traffic capacity is expressed in terms of PCU, and the figures on Table 7.2.2 are applied.

Table 7.2.2 Passenger Car Unit

Vehicles	PCU
Passenger Car	1.0
Taxi	1.0
Bus	3.0
Truck	3.0

3. Free Flow Speed

The six types of free flow speed as given in Table 7.2.3 are applied according the road link characteristics, taking the average free flow speed of all types of vehicles. Referring the actual speed limits on rural highways, which are 100 k/pH for buses and 70 k/pH for trucks.

Table 7.2.3 Free Flow Speed

Road type	Speed(km/Hr)
Toll Divided Highway	90
Other Divided Highways	80
Dual Carriage Highway with Carriageway of 7.5m	75
Dual Carriage Highway with Carriageway of 7.0m	70
Dual Carriage Highway with Carriageway of 6.5m	65
Dual Carriage Highway with Carriageway of 6.0m	60

4. Speed Reduction Formula

There are many formulas to express the relationship between volume Capacity Ratio (V/C) and travel speed. Fig. 7.2.1 shows a comparison of relationships of travel time increase (reciprocal of speed reduction) and v/c reported in the Engineering Research Bulletin of University of Helwan, Oct.1990, where JICA TS curve is the most pessimistic and the two curves of Federal Highway Administration, USA are too optimistic. The curves developed in UK, known as COBA (Cost Benefit Model) and MOTORS package show the intermediate results and do not exceed 1.0 of V/C. Also the theoretical relationship between link speed and V/C ratio is included in the figure. The following MOTORS curve will be applied to the study.

$$Ta = To \times (0.75 + 0.25 / (1.0 - V/C \times Q)$$

Where , Ta : Travel time having traffic volume V

To : Travel time by free flow speed

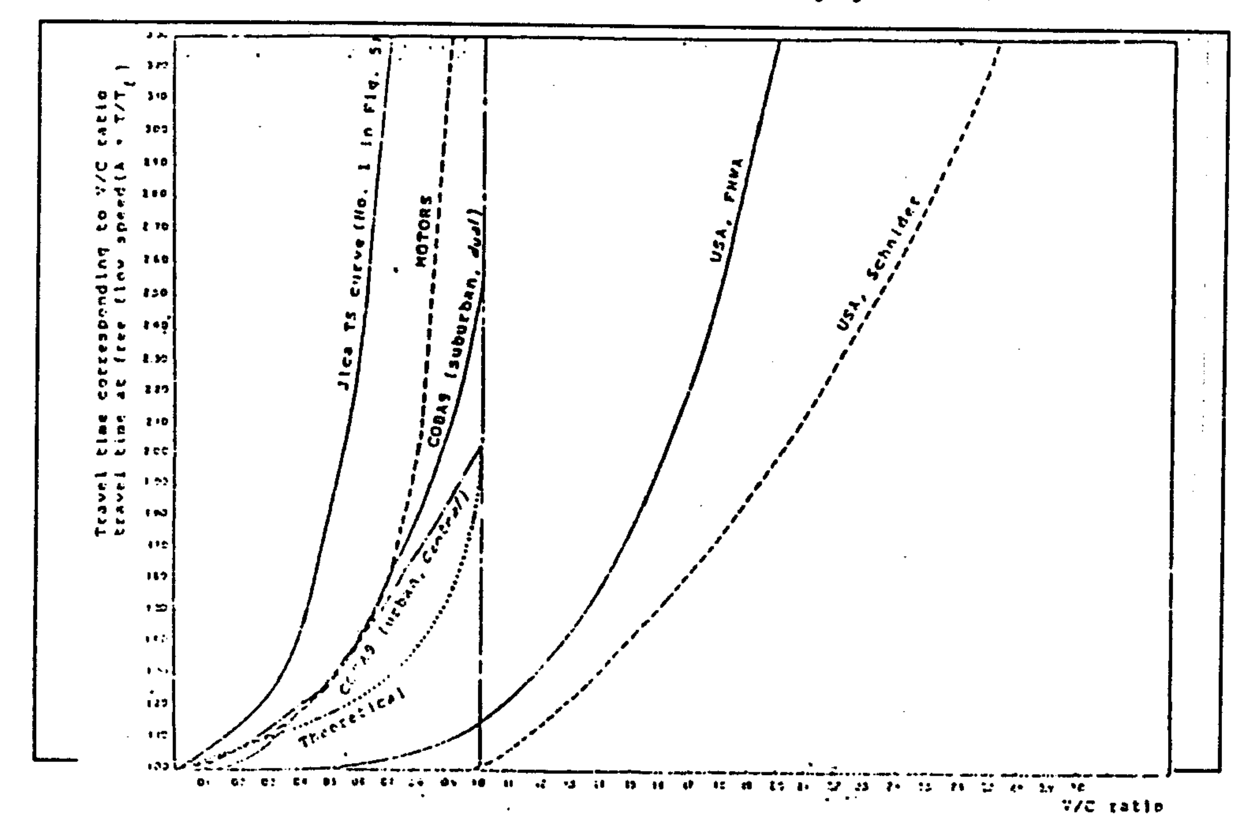
C : Link Capacity

V : Link Volume

Q : Factor (1.00)

Fig. 7.2.1 Comparison of the Trends of the CRF's according to different practices including the theoretical CRF

Source : Engineering Research Bulletin , University of Helwan , Oct. 1990.



5. Traffic Capacity

As a basic lane capacity, 2,400 pcu/Hr. is applied to the calculation and the lane capacity is reduced in accordance with the factors given in Table 7.2.4 by carriageway and shoulder width and the factors given in Table 7.2.5 by pavement condition.

Table 7.2.4 Capacity Reduction Factor by Width

Carriageway Width (M)	Shoulder Width (m)			
	0.00	0.50	1.00	1.50
7.5	0.88	0.93	0.97	1.00
7.0	0.84	0.89	0.93	0.96
6.5	0.76	0.80	0.84	0.87
6.0	0.71	0.75	0.70	0.81

Table 7.2.5 Capacity Reduction Factor by Pavement Condition

Pavement Condition	Reduction Factor
Good	1.00
Fair	0.92
Poor	0.81

7.3 Policy Alternatives for Demand Forecast

7.3.1 TRANSPORT DEMAND BY ALTERNATIVE SOCIO-ECONOMIC FRAME

In the chapter of socio-economic frame forecast , the GDP growth rate in real term was set at 5.1% p.a. for the period of 3rd 5 year plan of 1992 - 1996, and slightly high target of 6.5% p.a. afterwards , however an alternative case with the moderate growth with the same rate as in the 3rd 5 year plan period will be studied .

Figs 7.3.1 and 7.3.2 show the evolution of GDP in the base case and the alternative case with the growth rate of 5.1% p.a. after the 3rd 5-year plan period. The GDPS in the long term target year of 2012 were calculated at 414 billion LE in the base case and 339 Billion LE or 82% of the base case

in the alternative case. The passenger demand estimated based on these GDPs is given in Table 7.3.1. In the alternative case, the 2012 passenger demand was estimated at 82% of that in the base case, which is the same rate as GDPs, and corresponds to 2.33 times the 1992 demand.

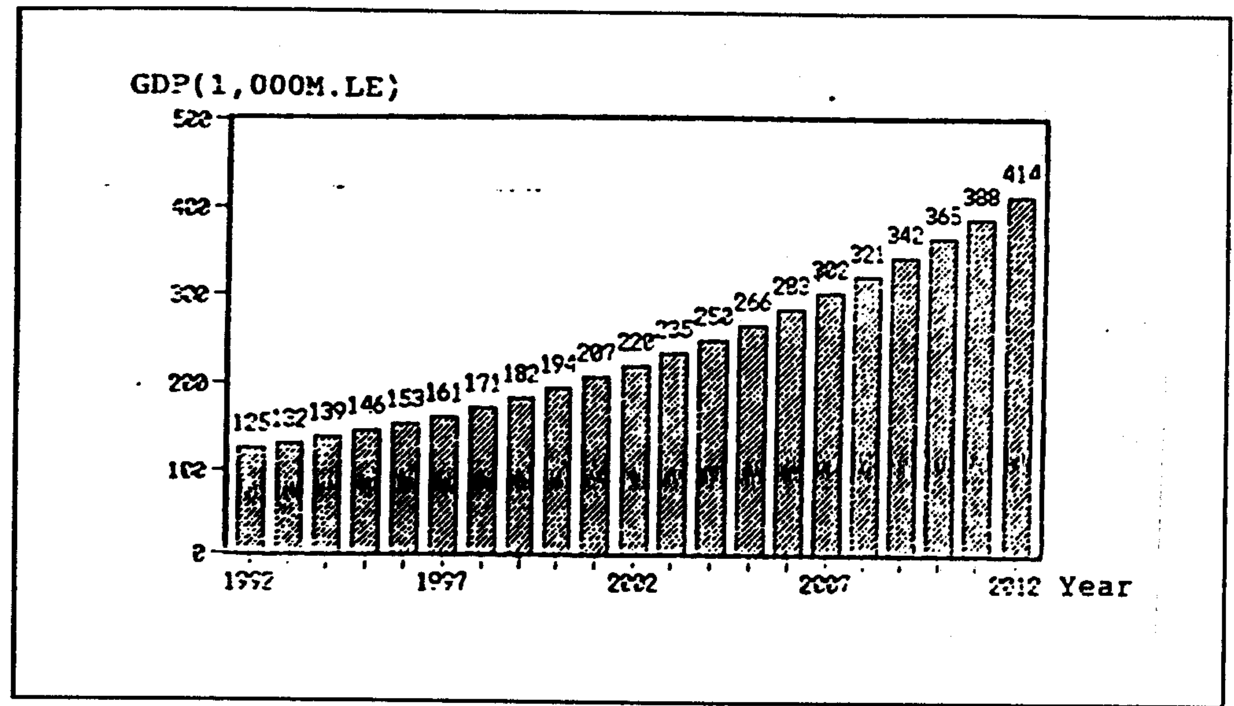


Fig. 7.3.1 Trend of GDP with Growth Rate of 6.5%

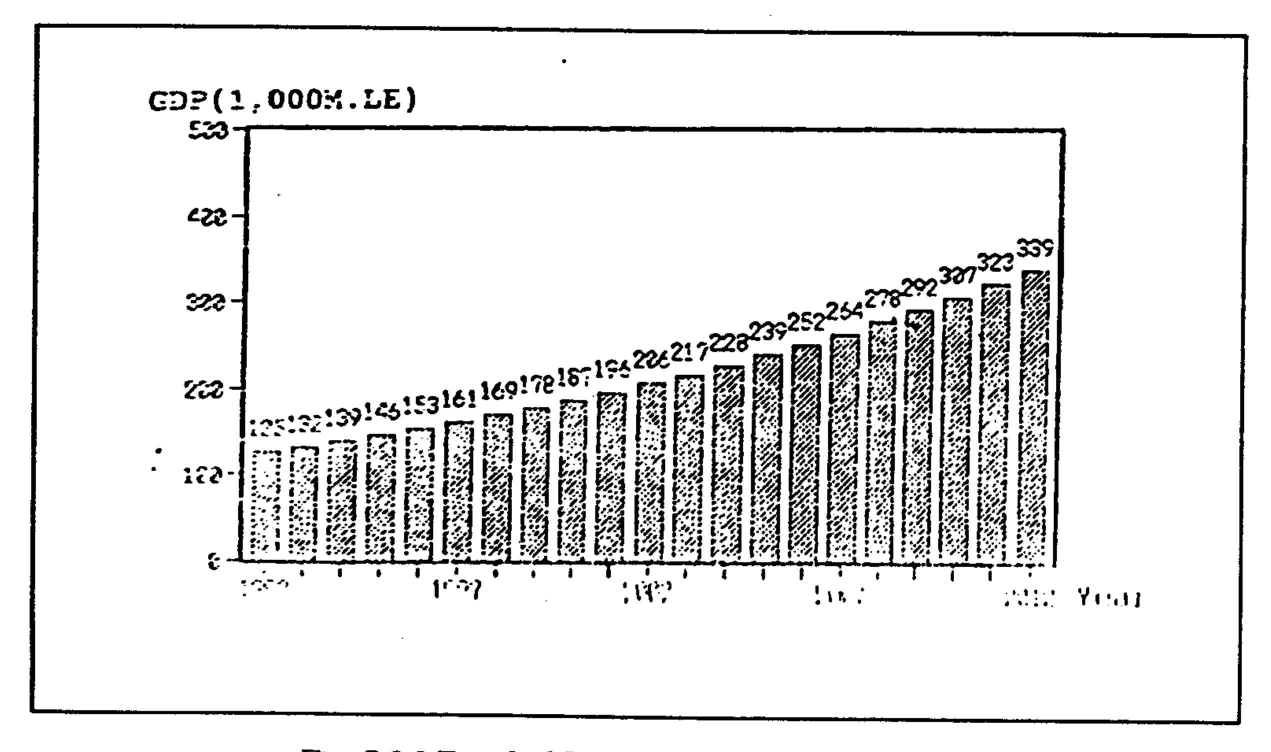


Fig. 7.3.2 Trend of GDP with Growth Rate of 5.1%

Table 7.3.1 Comparison of Passenger Demand with Different GDP Growth Rate

Item	A GDP 6.5% Case	B GDP 5.1% Case	B/A
GDP in 2012	413,573	339,116	0.82
Total Passenger	5,736,097	4,725,511	0.82
P. Car	558,330	459,733	
Taxi + Bus	2,349,625	1,936,159	
Rail	2,828,142	2,329,619	

Table 7.3.2 shows the comparison of freight demand in the year 2012 with different GDP growth rate factors in the 3rd 5 years planning period. The case with GDP growth rate of 5.1% p.a. will have 0.86 times of freight to the base case with GDP growth rate of 6.5% p.a. The most affected commodity is phosphate, which will have 0.64 times the base case.

Table 7.3.2 Comparison of Freight Demand with Different GDP Growth Rate

Commodity	6.5% (1,000ton/year)				5.1% (1,000ton/year)				5.1%/6.5%			
	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total	Hwy	Rwy	Wwy	Total
1 COIL	0	0	0	0	0	0	0	0	-	-	-	-
2 PETR	14,963	2,852	0	17,815	14,235	2,722	0	16,957	0.95	0.95	-	0.95
3 NGAS	0	0	0	0	0	0	0	0	-	-	-	-
4 CEMT	91,416	6,875	12,492	110,783	72,750	5,105	9,451	87,306	0.80	0.74	0.76	0.79
5 CMAT	192,277	11,170	576	204,023	166,610	9,672	499	176,781	0.87	0.87	0.87	0.87
6 PHOS	2,144	11,089	0	13,233	1,344	7,178	0	8,522	0.63	0.65	-	0.64
7 IORE	0	4,127	484	4,611	0	3,438	455	3,893	-	0.83	0.94	0.84
8 COAL	2,993	0	4,084	7,077	2,496	0	3,534	6,030	0.83	-	0.87	0.85
9 MNRL	2,129	60	11,427	13,616	1,745	46	9,239	11,030	0.82	0.77	0.81	0.81
10 WHET	11,491	2,557	3,235	17,283	11,013	2,697	0	13,710	0.96	1.05	0.00	0.79
11 CERE	12,132	240	0	12,372	11,813	161	0	11,974	0.97	0.67	-	0.97
12 FRUT	33,307	2	0	33,309	28,203	2	0	28,205	0.85	1.00	-	0.85
13 SCAN	141	0	764	905	134	0	715	849	0.95	-	0.94	0.94
14 FCRP	755	0	0	755	704	0	0	704	0.93	-	-	0.93
15 LSTK	2,338	0	0	2,338	2,099	0	0	2,099	0.90	-	-	0.90
16 APRD	4,038	9	0	4,047	4,016	9	0	4,025	0.99	1.00	-	0.99
17 AGPR	27,492	0	0	27,492	27,492	0	0	27,492	1.00	-	-	1.00
18 SGAR	1,082	6	2,175	3,263	1,075	6	2,144	3,225	0.99	1.00	0.99	0.99
19 FATS	1,870	1	2,090	3,961	1,653	1	1,921	3,575	0.88	1.00	0.92	0.90
20 AFED	26,462	28	0	26,490	21,895	23	0	21,918	0.83	0.82	-	0.83
21 BVRG	2,427	0	0	2,427	2,428	0	0	2,428	1.00	-	-	1.00
22 OFOD	5,560	22	0	5,582	5,544	38	0	5,582	1.00	1.71	-	1.00
23 CHEM	13,640	0	0	13,640	12,247	0	0	12,247	0.90	-	-	0.90
24 MTAL	11,184	5,088	87	16,359	10,784	4,265	90	15,139	0.96	0.84	1.03	0.93
25 TXTL	4,548	0	0	4,548	4,137	0	0	4,137	0.91	-	-	0.91
26 FTLZ	5,563	0	3,554	9,117	4,526	0	3,302	7,828	0.81	-	0.93	0.86
27 PULP	5,889	0	0	5,889	5,386	0	0	5,386	0.91	-	-	0.91
28 LUMB	3,916	152	0	4,068	3,442	135	0	3,577	0.88	0.89	-	0.88
29 MANU	19,512	1,396	7	20,915	16,893	1,219	7	18,119	0.87	0.87	1.00	0.87
30 MEXC	5,146	0	33	5,179	4,456	0	27	4,483	0.87	-	0.82	0.87
Total	504,415	45,674	41,008	591,097	439,120	36,717	31,384	507,221	0.87	0.80	0.77	0.86
Share	85.3	7.7	6.9	100.0	86.6	7.2	6.2	100.0				

Table7.3.3 shows the results of passenger and freight demand distribution, model split and conversion to vehicle generation demand. The total vehicle generation will reduce by 0.86 times to the base case by the decrease of GDP.

Table 7.3.3 Comparison of Vehicle Generation Demand with Different GDP Growth Rates

Vehicle type	(A) GDP 6.5% Case	(B) GDP 5.1% Case	(B)/(A)
P. Car	207,209	169,507	0.82
Taxi	208,237	173,305	0.83
Bus	36,661	29,579	0.81
Truck	291,768	268,031	0.91
Total	743,875	640,422	0.86

7.3.2 INTRODUCTION OF STANDARD RAIL FARE

ENR applies the many types of discount fare at present. If these discount fare systems is not applied, passenger may shift to the other transport modes.

Table 7.3.4 shows the result of this case. The same model split model was applied to estimate the passengers by mode with increased fare on ENR passengers. About 200,000 passengers in the year 2012 will shift to passenger car and bus or taxi, and the share of ENR will loose only by 2.0%.

Table 7.3.4 Standard Fare Case of ENR Passenger

Item	P.Car	Taxi + Bus	Rail	TOTAL
1. Pass./day (Excl. 188 Intra)				
1992(Obs)	205,363	824,541	997,972	2,027,876
1992(Est)	225,301	873,686	924,318	2,023,305
1997	290,209	1,124,830	1,186,324	2,601,363
2002	378,457	1,465,563	1,542,861	3,386,881
2012	641,986	2,477,980	2,606,272	5,726,238
2. Growth Rate (19920 bs. = 1.00)				
1992(Obs)	1.00	1.00	1.00	1.00
1992(Est)	1.10	1.06	0.93	1.00
1997	1.41	1.36	1.19	1.28
2002	1.84	1.78	1.55	1.67
2012.	3.13	3.01	2.61	2.82
3. Composition (%)				
1992(Obs)	10.1	40.7	49.2	100.0
1992(Est)	11.1	43.2	45.7	100.0
1997	11.2	43.2	45.6	100.0
2002	11.2	43.3	45.6	100.0
2012	11.2	43.3	45.5	100.0

CHAPTER 8

8.1 Introduction

This chapter is devoted to a consideration of various technical and economic aspects of upgrading inland waterway systems.

Chapter 2 sets out a general procedure, which indicates systematically how, planning studies for the construction or improvement of waterway, can be organized. The most important step in the procedure is listing the measures, which can be taken to improve the existing situation: it is essential that the design team devote a good deal of attention to this. An inventive selection from the options can often result in considerable cost-savings:

Some examples are given in Chapter 3 and 5.

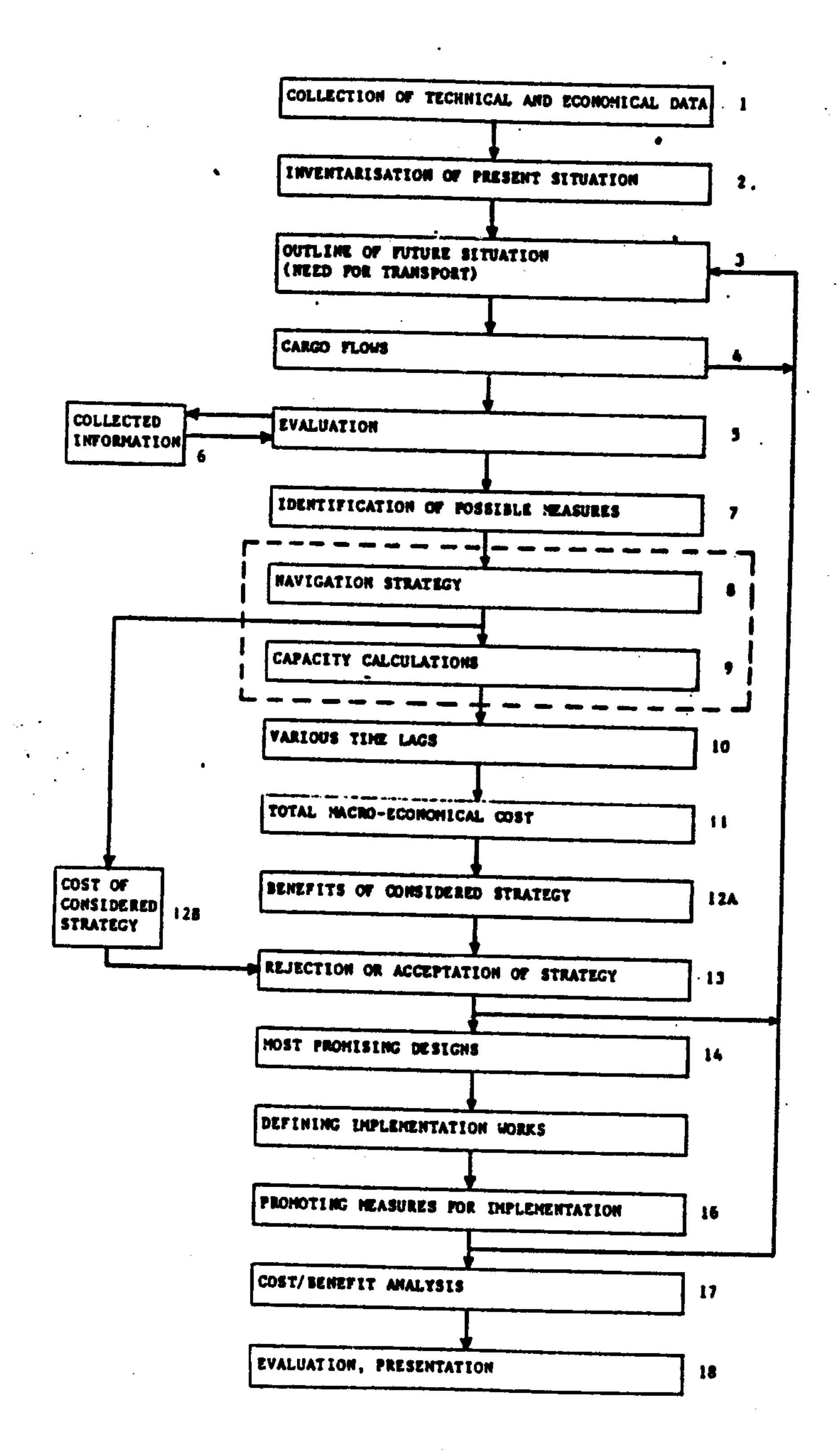
Chapter 3 deals with areas where there is already a well-developed network of waterways, in particular the Netherlands. Following a brief outline of the planning procedure for improving Dutch waterways, two questions in particular are considered:

- In what circumstances is it economically feasible to upgrade a waterway?
- How can the investment be made to yield the best possible returns?

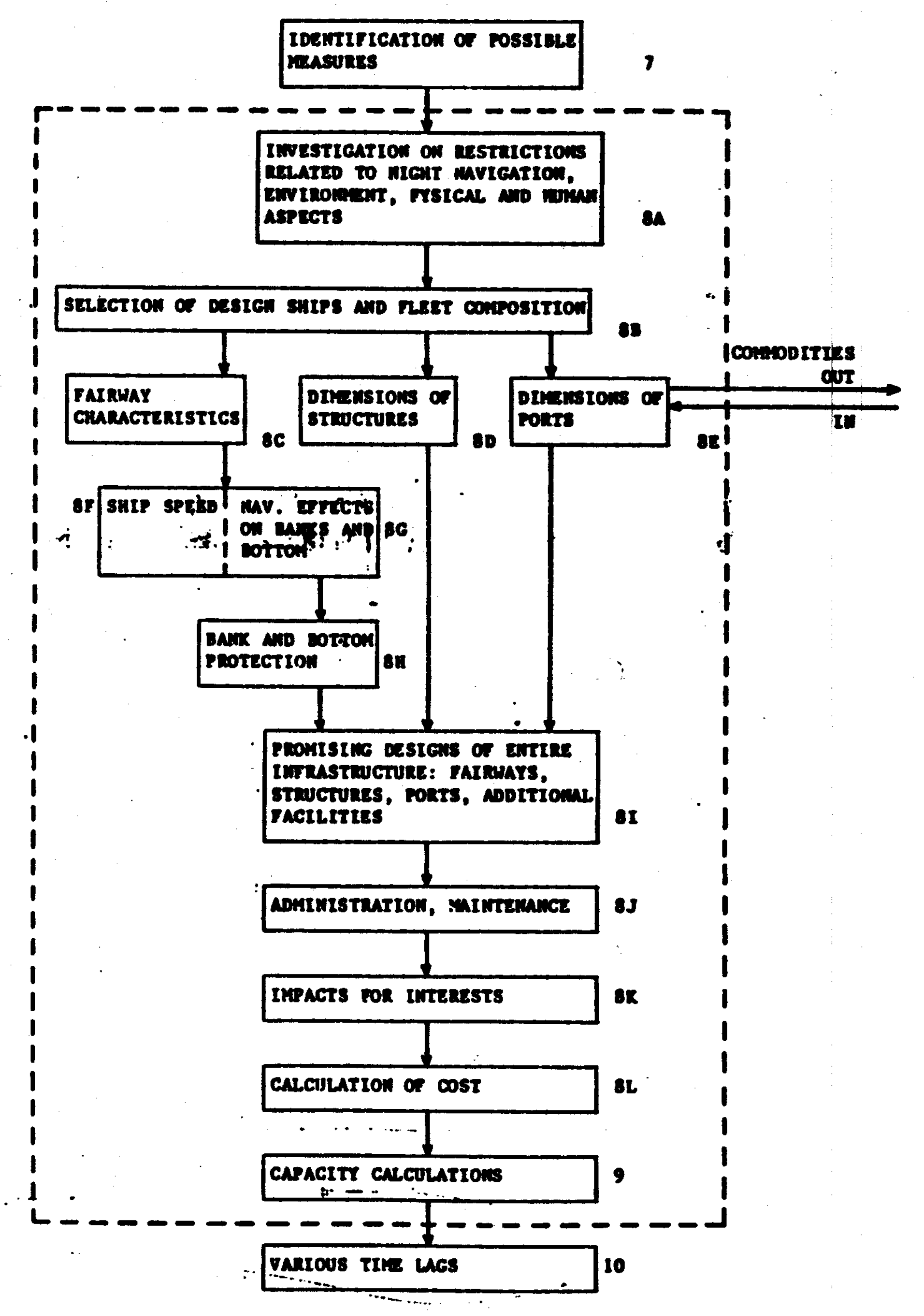
Guidelines for the design of small and medium-sized waterways and engineering structures (admissible carrying capacity 300 - 1,500 ton) are currently being in the Netherlands: these are outlined, and various aspects of their drafting are discussed, in Chapter 4. Lastly, Chapter 5 deals with " Less developed waterway system ", first the planning procedure and then two universally applicable inexpensive ways of improving existing natural rivers.

8.2 Planning Procedure

Figures 8.1 and 8.2 show an universal technical and economic planning procedure which can be applied to any design for a new waterway or waterway improvement scheme.



COLLECTION OF TECHNICAL AND ECONOMICAL DATA
1
INVENTARISATION OF PRESENT SITUATION
2.
OUTLINE OF FUTURE SITUATION
(NEED FOR TRANSPORT)
3
CARGO FLOWS
4
COLLECTED INFORMATION
6
EVALUATION
5
IDENTIFICATION OF POSSIBLE MEASURES
7
NAVIGATION STRATEGY
8
CAPACITY CALCULATIONS
9
VARIOUS TIME LAGS
10
TOTAL MACRO-ECONOMICAL COST
11
COST OF CONSIDERED STRATEGY
12B
BENEFITS OF CONSIDERED STRATEGY
12A
REJECTION OR ACCEPTATION OF STRATEGY
13
MOST PROMISING DESIGNS
14
DEFINING IMPLEMENTATION WORKS
PROMOTING MEASURES FOR IMPLEMENTATION
16
COST/BENEFIT ANALYSIS
17
EVALUATION, PRESENTATION
18



The procedure can be divided into three phases:

Phase 1: Collection of data, both technical and economic (steps 1 - 6);

Phase 2: Rough listing and evaluation of possible measures (steps 7 - 13);

Phase 3: Selection of the best measures (steps 14 - 18).

The following comments may be made on the procedure.

a. In many cases it is not necessary to follow the entire planning procedure step by step: some steps may be omitted. Even then, however, it is worthwhile to use the procedure so those steps are no forgotten.

b. It often happens that the technical and economic data needed at the beginning of a study are not available. This is not a serious problem.

To avoid unnecessary work a rough estimated of the effects of the various measures can be made and a general idea formed of which measures are promising or otherwise and what additional data are needed.

Details calculations etc. can then be made for the most attractive designs. The various steps in the planning procedure sometimes have to be passed through several times during this selection process.

c. The most important step in the planning procedure is step 7, which involves listing the measures, which could be taken to improve the existing situation. It is essential that design team devote a good deal of attention to this and adopt a creative approach. An inventive selection from the options can often result in considerable cost-savings which might otherwise passe unnoticed.

The following comments may be made on particular steps in the procedure.

Step 5: This entails evaluating the available data and expectations for the future. Note should also be taken of any gaps in Knowledge: additional information may be collected as a result (step 6).

Step 6: This entails establishing the dimensions of the entire infrastructure and fleet. Fig. 8.2 shows this in diagrammatic form. First (8A) the restrictions in the area under consideration are examined, i.e. such things as the physical restrictions of the existing waterways and the possibility of changing them; the nature of the soil; the environment; human aspects; the availability of dredgers, construction equipment and material and transportation; and the possibility of navigation at night.

On this basis one or more "design ships" are selected and a rough indication of the vessel mix in the remainder of the fleet is obtained (step 8b). This means that the total number of ships and the distribution of the various types with dimensions, engine size and characteristics are known approximately. The dimensions of the fairways, engineering structures and harbours are

then based on the selected vessel mix (8C, 8D and 8E) and supply and discharge are coordinated. Form the data on the types of ship, sailing speeds (8 F) and fairway dimensions the effect on beds and banks can be established (8G), and from this data on the bank and bottom protection needed (H).

Steps 8G and 8H yield a number of promising designs for the entire infrastructure (8I). Given this, the measures needed for safe and expeditious navigation (buoys, positioning system, Vessel Traffic Management System, operation and energy consumption of locks and bridges, admittance policy, etc.) and the maintenance work required (dredging, locks and bridges, bank protection can be determined (8J). The next step (8 K) is to decide what effecting other uses (e.g. irrigation and flood control) have on the design. Step 8 concludes with computations of the costs of the various designs: the capitalized costs of maintenance and operation should be taken into consideration, as well as the cost of construction.

Step 9: This entails computing the capacities various components (locks, fairways, overtopping and storage facilities).

Step 10: Various times follow from the computed capacities, e.g. waiting times at locks and bridges, navigation times and ships' waiting and loading/ unloading times in harbors.

8.3. DEVELOPED WATERWAY SYSTEMS: THE DUTCH WATERWAY NETWORK

8.3.1 GENERAL SITUATION:

Fig. 8.3 shows Dutch waterway network and the amounts of freight carried on the various routes.

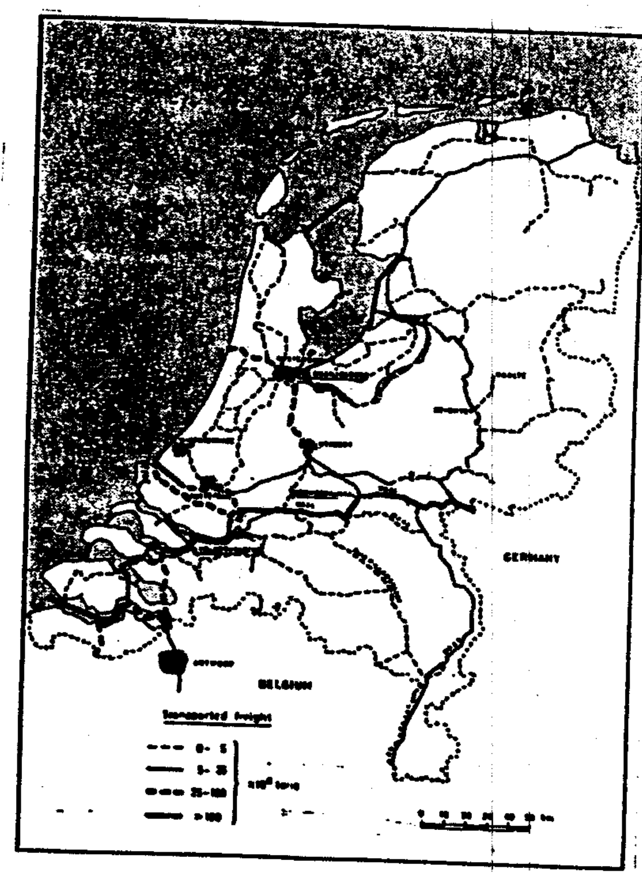


Fig. 8.3

8.3.2 PLANNING PROCEDURE

The planning procedure outlined in Chapter 2 is used as follows in the Netherlands.

1. Technical and economic data which may be useful for the upgrading of the waterway network are collected in sufficient quantity on a continuous basis (step 1).

2. The Dutch authorities use a mathematical model to make forecasts of traffic and traffic volume on the entire Dutch waterway network, taking account of such things as:

   a. Expected economic developments in the Netherlands and a number of neighbouring countries;

   b. Regional developments

   c. The consequences of a. and b. on the transported quantities of various kinds of goods;

   d. The cost of transport by road, rail and water and the resulting modal split for each mode of transport and type of freight.

The effect of improvements in the waterway network on the cost of transport and the traffic volume can be computed approximately with this model, which is also an aid to locating future bottlenecks in the waterway network.

3. In 1975 the Government published a National Plan on Waterways which passed through a public participation procedure.

4. From 1984 onwards the Government aims to replace this Plan by a ten-year Plan on Waterways, which will be updated every year and presented at parliament. It will set out such items as:

   a. The state of the waterway: improvements at hand;

   b. Present and expected future problems;

   c. The waterway improvements the Government is thinking of carrying out in the future; the ten-year Plan broadly outlines the need for them, possible alternatives and the advantages and disadvantages of these schemes;

   d. The urgency of the various schemes;

e. Particulars of various feasibility studies which are to be carried out.

5. The schemes mentioned at 4c. are elaborated, analysed and developed separately, following the entire planning procedure outlined in Chapter 2 once more. Public participation also takes place before it is finally decided to implement them.

6. The feasibility studies mentioned at 4. are also carried out separately. The results may be incorporated in a subsequent ten-year Plan, or they may give rise to a more detailed project analysis, or the abandonment of the scheme.

8.3.3 THE UPGRADING OF EXISTING INLAND NAVIGATION SYSTEMS; ECONOMIC ASPECTS

Two questions arise as regards the upgrading of an existing waterway network:

1. Under what conditions is it economically feasible to upgrade a waterway?

2. How can the investment be made to yield the best returns?

These questions are dealt with systematically below on the basis of various studies and experience in the Netherlands in recent years.

1. New waterway construction

The construction of an entirely new waterway may be economically feasible only if three conditions are all satisfies:

a. Large quantities of bulk freight are transported between two places, or this is expected to be the case in the future.

b. The two places are not connected by a waterway, or a time-consuming detour has to be made using existing waterways.

c. The new waterway can be constructed over relatively flat terrain, crossing existing road and railroad connection and built-up areas to only a limited extent.

The first two conditions must be satisfied to provide sufficient cost-savings to justify a new connection. The savings are then created by the changeover from road or rail haulage to the less expensive waterway transport or by saving time and energy for shipping. The third condition is decisive in

ensuring that the investment (in such things as locks, bridges, earth-moving work and expropriation costs) is not too high.

During recent years a number of cost-benefit analyses to determine the possibilities of constructing completely new waterways have been carried out in the Netherlands. In general the results have not been favorable.

CONCLUSION :

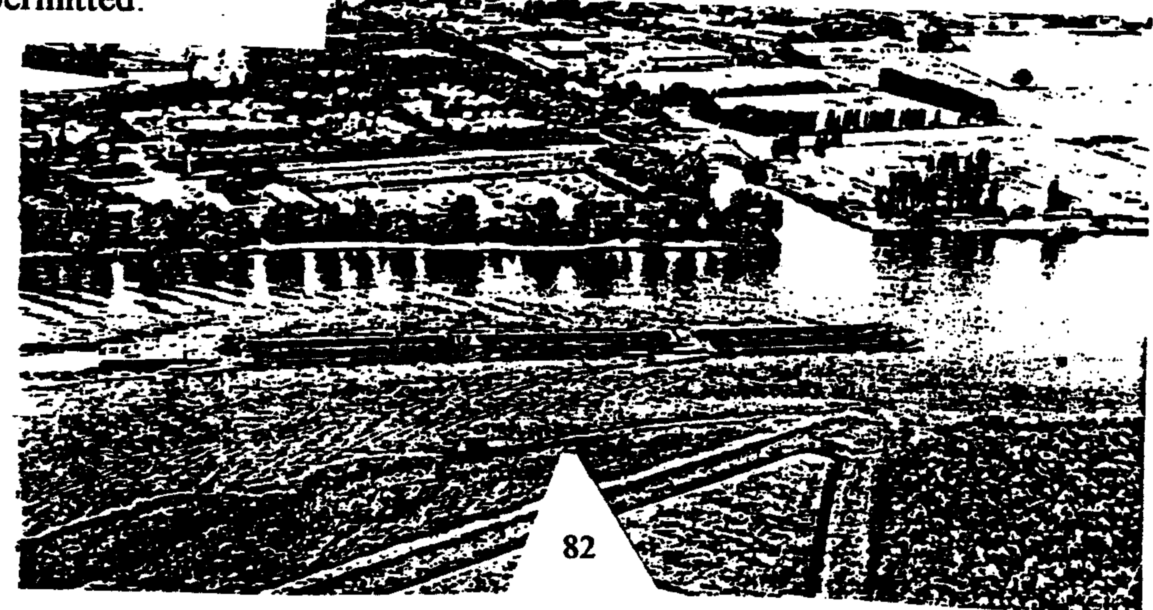
A country with such a fine-meshed inland navigation system as the Netherlands is so well served with waterways that the construction of an entirely new waterway is likely to be economical only in exceptional cases.

2. Improving waterways with a high volume of traffic:

Here those waterways are first selected which carry a lot of traffic, or may be expected to do so in the future. Improving them is generally likely to result in a considerable saving in transport costs, especially if the waterway in question is accessible only to ships of a limited cargo capacity, and after the improvement either this capacity can be increased substantially or there will be a considerable time-saving.

The advantages of any change in the model split from rail and road haulage to inland shipping should also be taken into account. On the other hand, such improvements usually require large investments. The results yielded by this method, depending on the rate of discount applied (until recent it was 10% in the Netherlands, but it is currently lower), turn out sometimes in favour but more often not in favour of improvement.

An investigation of this kind is the unfinished study of the possibility of admitting six-barge push-tow units (16,500 tons) to the Rotterdam-Germany route (Fig. 8.4), where four-barge units (11,000 tons) are currently permitted.



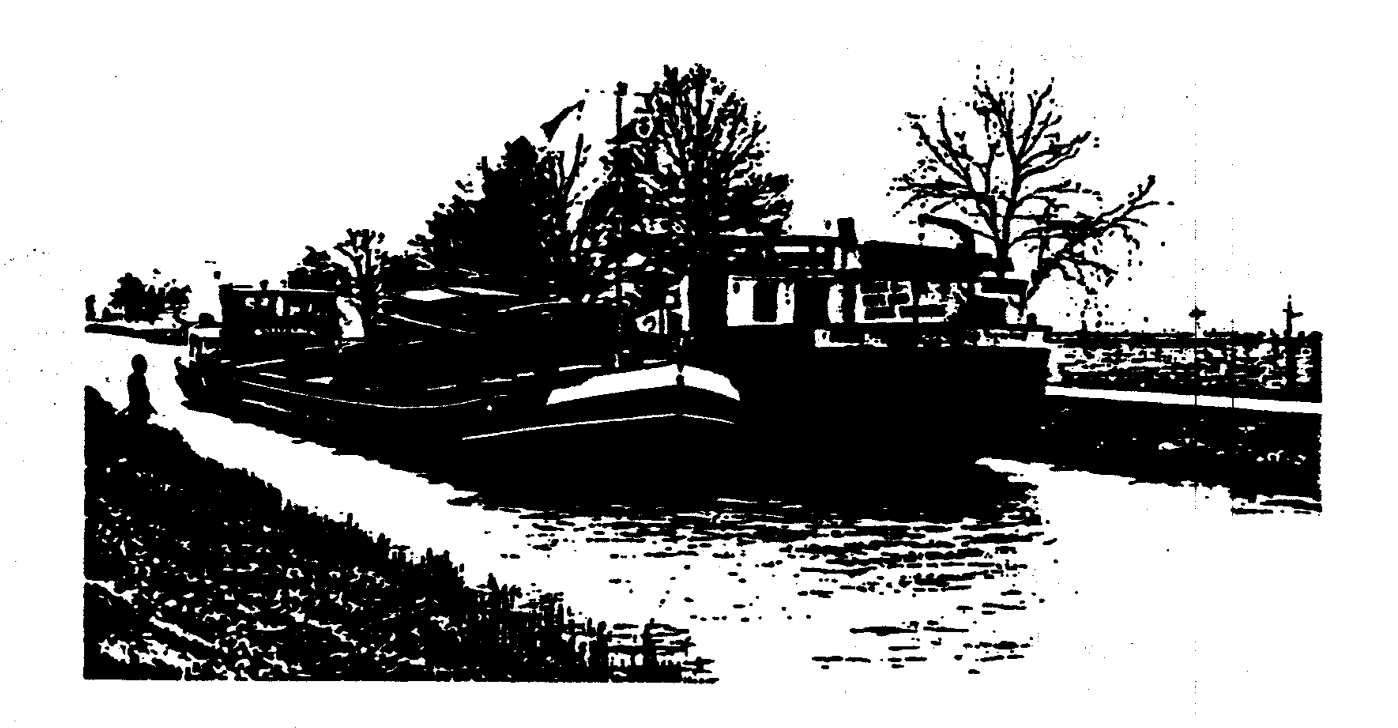


Fig. 5: ENCOUNTER ON THE DEVENTER-RAALTE CANAL

3. Low-budget improvements:

This method entails investigations whether there is a possibility of reducing the transport costs with a comparatively small investment. A great deal depends on the inventiveness of the research team here.

Examples are:

a. Improving local bottlenecks: for an example see 4b, the Oranje Locks. *

b. Increasing capacity by imposing one-way traffic (for the largest units)

Example 1: Two-barge push-tow units on the *Maas.*

So far only ships less than 12 m wide and 100 m long (carrying capacity approx. 2,500 tons) have been permitted on the Maas. A study has shown that a large part of the river is suitable for two-barge push-tow units (capacity approx. 4,000 tons) provided these units are subject to one-way traffic on certain narrow parts of the river.

* *For the geographical situation, see Fig. 8.3*

Example 2: The Deventer - Raalte *Canal* (see Fig. 8.5).

At present this canal is navigable only by small barges (peniches 300 - ton vessels) loaded at most to a draught of 1.45 m , and able to carry only 160 tons of cargo . In the Dutch situation a vessel is unable to compete with road haulage, if it can only carry such a small amount of cargo. The canal has consequently lost traffic.

Four options were studies:

- Closing the canal;
- Improving the canal to make it a proper 300-ton route;
- Maintaining the present situation; and
- Improving the canal to make it a 300-ton route for one-way traffic using the convoy-system.

The investigation shows the last option as the most attractive. The benefits almost equal a full-scale 300-ton route, but the investments for the enlargement of the cross-section and bank protection are lower. Nevertheless the canal will probably be closed in the future, since national and local authorities cannot reach an agreement over the division of the cost.

Obviously in many cases one-way traffic is not very desirable from the point of view of traffic flow, nor is it always feasible from the navigational point of view. Nevertheless it can provide a good way to increase the admitted carrying capacity of the largest vessels using a waterway, if increasing the size of the waterway is expensive or undesirable, e.g. if the waterway crosses a town, hilly terrain or a nature area. In this case some form of traffic regulation is required. Moreover, previously it must be established whether the waterway has sufficient capacity to cope with the traffic; in some cases waiting facilities must additionally be created for vessels.

c. Increasing capacity by using small push-tow units:

There are a large number of small waterways in the Netherlands, which at present are accessible to vessels of a limited capacity (300 - 600 tons). The dimensions of the lock chambers usually determine the largest size of vessel, which may be permitted on these waterways.

In the short term a considerable increase in capacity could be achieved if navigation with push-tow units consisting of two series-coupled vessels could be permitted. At a lock the vessels would have to be uncoupled and

then the two vessels would have to pass through separately. The same procedure might be necessary on sharp bends.

At narrow bridges the guiding structure would have to be improved. Crosswinds would be a major problem, since the longer push-tow units need a fairly large path width as a result. Instead of a stiff coupling a flexible coupling in combination with central steering, allowing both units to turn independently, might be considered also.

d. Reducing keel clearance

In many cases the sill depths of lock entrances determine the admissible draught of vessels on a waterway. Currently is under investigation whether the admissible draught on the Maas with her many locks can be increased from 2.8 to 3 m. Caution is called for, since this would increase the risk of vessels touching the sill when entering the lock. In the Netherlands to reduce this risk an echo sounder has been developed to measure the draught of vessels before they enter a lock.

8.4. The capacity of existing locks

a. Traffic volume

When the amount of traffic increases locks are frequently unable to cope with it any more. To overcome this problem a new lock chamber of the same size, or at slightly grater expense a larger one, can be built. In such cases it is often economical to increase the admitted carrying capacity by enlarging not only the locks but also the cross-section of the adjacent waterway. Caution is called for when choosing between the options, as is shown by the following example.

Example: The Volkerak Locks (1). Around 1970 it was found that the volkerak Locks (with two lock chambers) did not possess sufficient capacity to cope with the traffic. It was decided to construct a third chamber, since this was the obvious solution. The enlarged lock complex now includes a third chamber and a lock for yachts. Since in 1970 it was going to take some considerable time before these were completed and a sharp increase in shipping was expected, it was decided to investigate whether the capacity of the existing locks could be increased. It was found that 10-20% increase of the capacity could be achieved, by a combination of the following measures:

- Speeding-up the movement of gates and valves;
- opening the gates just before the water levels coincided;

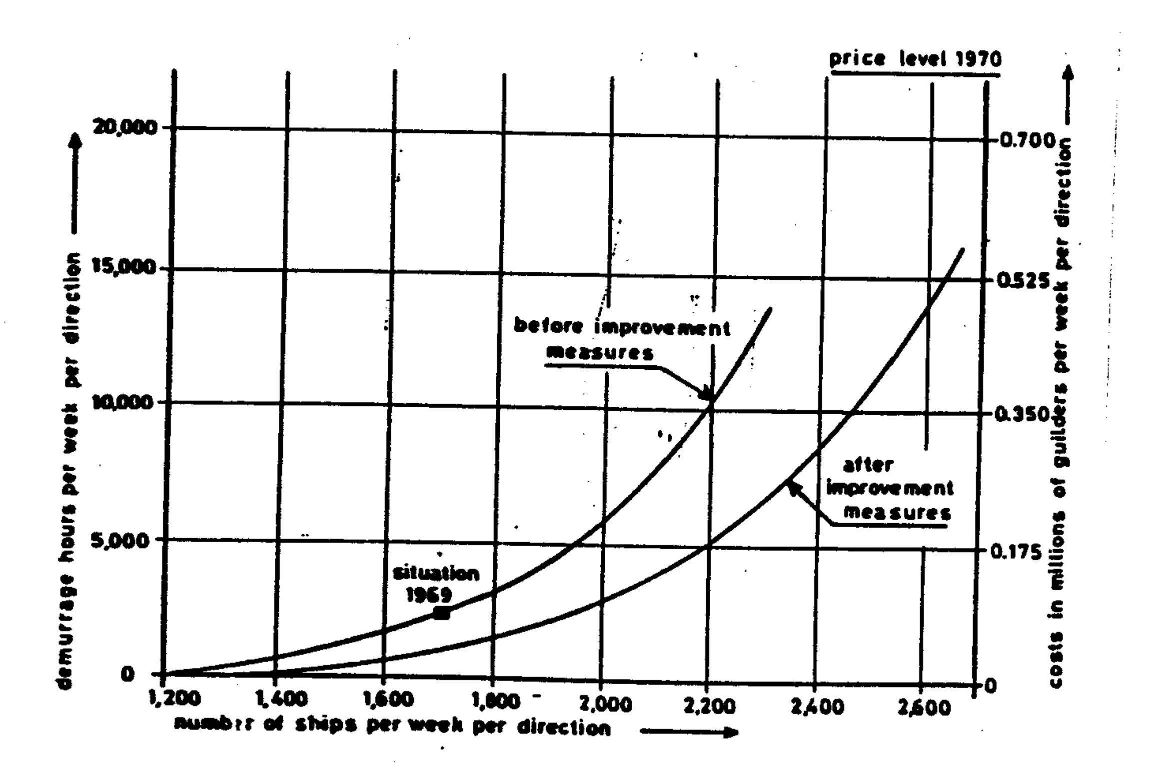
- Improving the operating, information and communications systems.

The cost of these measures was 2.2 million guilders (at 1970 values), and they yielded a manpower saving of six jobs. Fig. 8.6 shows the effect of these measures on shipping.

Notice that, at the time, it cost 40 million guilders to build one new chamber, which yielded a 50% increase in capacity. Thus for each guilder invested, the measures to improve the efficiency of the existing locks provided a much larger increase in capacity than the construction of new chambers. Two conclusions of general application can be draw from the volkerak example:

1. Every lock, or for that matter movable bridge or one-way traffic shipping route, has a kind of turning point. If traffic volume remains below this point, there is virtually no demurrage time; if it rises above it, the demurrage time suddenly starts to increase sharply as the amount of traffic rises (see Fig. 8.6). If traffic is increasing sharply and measures are delayed until the turning point is reached, there is a danger of being too late.

2. If the turning point has almost been reached, it is worthwhile to investigate whether the operation of the locks can be improved. This can often be done at relatively little expense, in some cases enabling a much larger investment to be postponed for some years.



b. Increasing vessel size

Even if the amount of freight carried remains constant or decreases, a lock complex may become overworked, thus making it economical to increase its capacity.

Example: The *Oranje* Locks.

These are accessible to 1,500-ton vessels and are situated on a route, which is otherwise accessible to two-barge push-tow units (of 5,000 tons). The complex comprises three chambers, the central one 85 m long and the other two 65 and 70 m long (see Fig. 8.7). It is heavily loaded.

The average size of the vessels passing through is 675 tons at present, but there is a sharp increase-taking place in vessel size. Consequently more and more vessels which can only pass through the central chamber are arriving. If this trend continues there will be a sharp drop in locking capacity (see Fig. 8.8) and the complex will be overworked.

Within a short time work will start on the construction of a new larger chamber, accessible to two-barge units, which a study has shown to be economical.

LOCK DIMENSIONS

$W_1 \times L_1 = 14 \times$ about $70\ m^2$

$W_2 \times L_2 = 18 \times$ about $85\ m^2$

$W_3 \times L_3 = 14 \times$ about $65\ m^2$

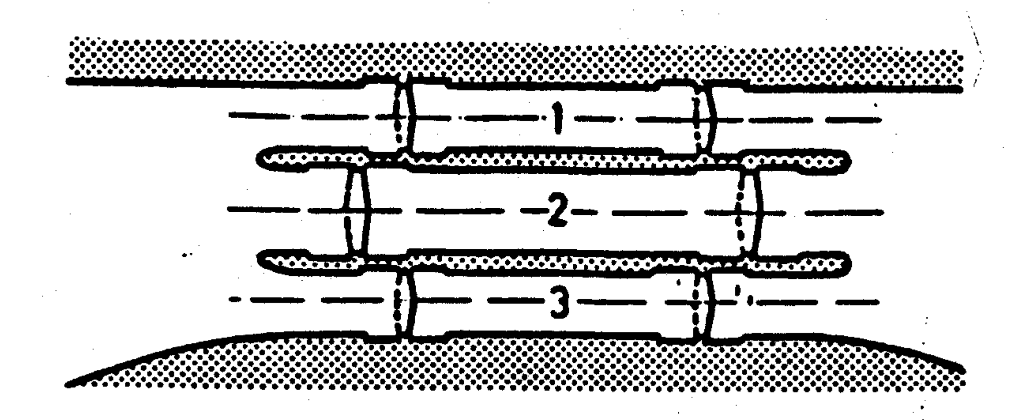


Fig. 7: LAY OUT ORANJE LOCKS

8.5 Obsolete waterways: close them down, let them go on deteriorating, restore them, or upgrade them?

Some of the Dutch waterways are over 100 years old. As the engineering structures get older they need more and more repairs, thus increasing the cost of maintenance. They can also break down and cause long hold-ups to shipping at unexpected times. When this is the case the options are:

- To close down the waterway;
- To continue to operate it as before;
- To restore the engineering structures;
- To enlarge the waterway.

As long as a reasonable amount of freight is being carried on a waterway (over 1/2 million tons a year), closure is likely to be uneconomic. The cost of upgrading in some cases is not much greater than that of the other options. On the other hand an improvement scheme can often produce a considerable saving in transport costs: in such cases it may be economical. For an example see 6, the Zuid - Willemsvaart.

8.6 Multi-purpose projects

An improvement scheme can produce a reduction in the cost of transport as well as other advantages to the community. If consideration is given to these the benefits from a scheme can sometimes be increased considerably. A study of ways of improving the Zuid-Willemsvaart , for instance , showed that the scheme had the following advantages :

- Engineering structures in bad repair owing to age would be replaced;
- Haulage costs would be reduced;
- The cost of maintenance (bank protection, locks, bridges and dredgers) would be reduced;
- Improved water discharge would benefit agriculture;
- There would be positive effects on employment (work on the improvement of the canal and the possible settlement of new industries);

- There would be manpower savings in the operation of locks and bridges;
- The substitution of fixed bridges for movable bridges would reduce the cost of waiting for land traffic;
- Excavated sand and clay could be sold;
- Facilities for pleasure craft would be improved.

8.7 The operation of locks and movable bridges

Many locks and bridges in the Netherlands are still operated in an old-fashioned way. A number of studies carried out in recent years have shown that labour-saving methods of operation can often produce a major reduction in cost. These include the following:

a. Remote control:

By this means several locks or bridges can be operated at the same time from a central post, if necessary using visual aids such as television or radar.

Example: the Merwede-Canal

The southern part of this canal is 23 km long and contains two locks and fourteen movable bridges, all of them operated on the spot. Every year the canal carries some 11,500 commercial vessels with a total carrying capacity of 1 million tons and 10,000 pleasure craft. Thirty-two operators are required; remote control would produce a manpower saving of fourteen, and the benefits would far exceed the cost according to a cost-benefit analysis (with a 10% rate of discount).

b. More efficient operation of locks

For an example see 4.a., the Volkerak Locks.

c. Mobile operation

Here the operators travel with a vessel or group of vessels and operate the locks and bridges: this system is used on a number of waterways in the Netherlands.

d. Use of part-time operators

Because of the number of pleasure craft the traffic volume on some waterways is particularly high during the holiday season, just the time when few operators are available. The use of part-time operators (working

students ; waterway employees who do other jobs in the winter) may be economical here .

e. Self-service

This entails the crews themselves operating the locks and bridges. Currently some designs for modern self-service locks are being made in the Netherlands.

f. Automatic operation

Here the locks and bridges are operated entirely by electronic equipment, which is automatically triggered by the approach of a vessel or vehicle. There is no experience with such systems on Dutch waterways as yet.

g. Substitution of fixed for movable bridges

This is sometimes found to be economical.

8.8 Standardization of construction methods and maintenance

In some case standardization of engineering structures and bank protection, taking account of both the interchangeability of components an construction and maintenance costs, can result in major savings. In this connection a study of the construction and maintenance costs of various types of bank protection is soon to be undertaken in the Netherlands.

8.9 The effectiveness of the fleet

The following measures are examples of those that can be taken to ensure that shipping is able to use the waterway network as effectively as possible:

a. Providing information to shipping

E.g. on expected conditions such as depth, icing , obstructions .

b. Providing beacons and buoys to mark shallows

c. Facilities for 24-hour navigation

(Radar beacons and 24-hour manning of locks and movable bridges)

d. Reducing waiting times in harbours and at locks and bridges

In many countries a great deal of times is wasted when loading, unloading, and waiting for cargoes and at locks and bridges.

e. Exchange of information between locks

An information system, which enables information on passing vessels to be exchanged between the various locks, is currently on trial in the Netherlands. This enables the operation of locks to be geared to the shipping expected, thus reducing passing vessels' waiting times and at the same time reducing the energy costs of pumping water back into the upper reaches or of salt water/fresh water separation systems. It also gives a general idea of the whereabouts of vessels carrying dangerous substances.

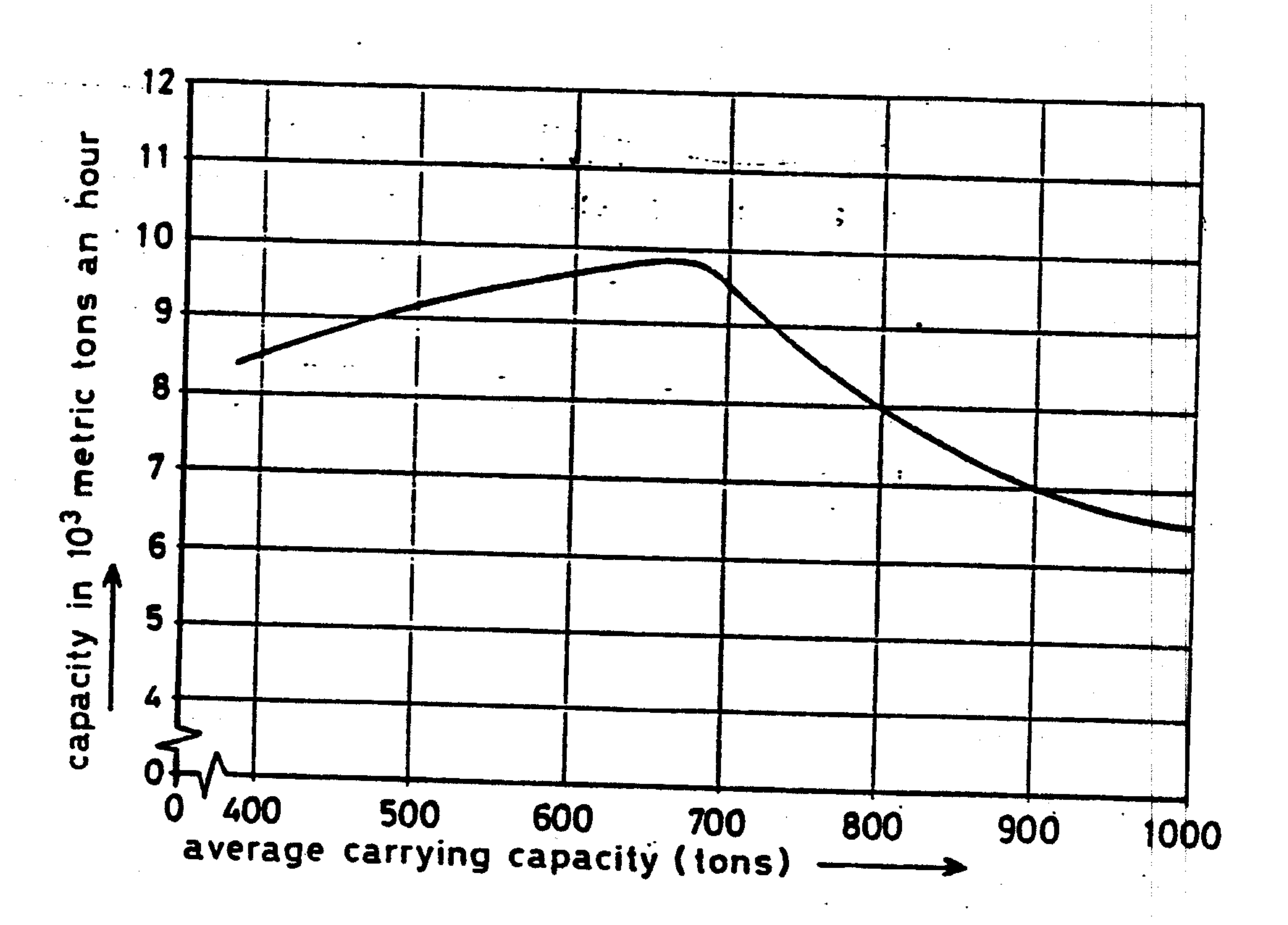


Fig. 8: ORANJE LOCKS, RELATION BETWEEN LOCK CAPACITY AND AVERAGE CARRYING CAPACITY

CHAPTER 9

9.4. Developing guidelines for the design of waterways, locks and bridges

9.4.1 INTRODUCTION

The ECMT (European Conference of Ministers of Transport) made a recommendation in 1954 that the Western European waterways should be divided into five classes. A waterway is in a particular class if it is accessible to vessels of the standard beam appropriate to that class (see table 1). The Netherlands subsequently added a Class VI for waterways accessible to four-barge push-tow units with a cargo capacity of approx. 10,000 tons.

As well as a number of major waterways, the Netherlands has an extensive network of small and medium-sized waterways (300 - 1,500 tons). The accent in developing the waterway network is on improving the major waterways, but it frequently happens that small and medium-sizes waterways are improved or require other measures such as the construction of new bridges.

Three problems were experienced in this connection:

1. There were no general applicable guidelines for the design of waterways and engineering structures, with local differences as a result.
2. The standards applied to the admittance of vessels were not the same throughout the country.
3. Investigations indicated that the dimensions of present-day vessels differ from the ECMT standard dimensions.

To solve these problems it was decided to draw up guidelines for the design of small and medium-sized waterways. This Chapter gives a summary of these guidelines and considers various aspects of their drafting.

9.4.2 DESIGN SHIP DIMENSIONS

First the dimensions of the inland shipping fleet active in Western Europe were analysed with the aid of the Rhine Shipping Register (2). The analysis showed that the widths of the majority of vessels corresponded to one of the standard ECMT beam sizes (see Fig. 9).

These dimensions were obviously worth retaining, therefore. It was further found that a reasonable number of vessels had a beam of approx. 7.20 m, which happens to be the maximum admissible beam on certain not unimportant Dutch waterways. It was therefore decided to add this to the ECMT classification as Class IIA.

The length, draught and clearance heights of vessels were generally found to be large than the standard ECMT dimensions (Fig. 9.1). It was therefore decided as follows:

1. For the *classification of waterways* the ECMT standard dimensions will continue to be the yardstick in the future .The existing ECMT classification system, which is also used in Germany and Belgium, has been retained, then.
2. The design of waterway improvements and construction of locks and bridges will be based on current vessel dimensions, and admittance policy will be brought into line with them gradually.

- Figure 9.2 shows the lengths of current vessels; the lengths of the design ships have been based on the predominant lengths in each class as shown in the figure.

- The height exceeded by 10% of unladen vessels in a particular beam category has been taken as the design clearance height (H).

- The draught reached by 50% of vessels in a particular beam category when fully laden has been taken as the design draught (T).

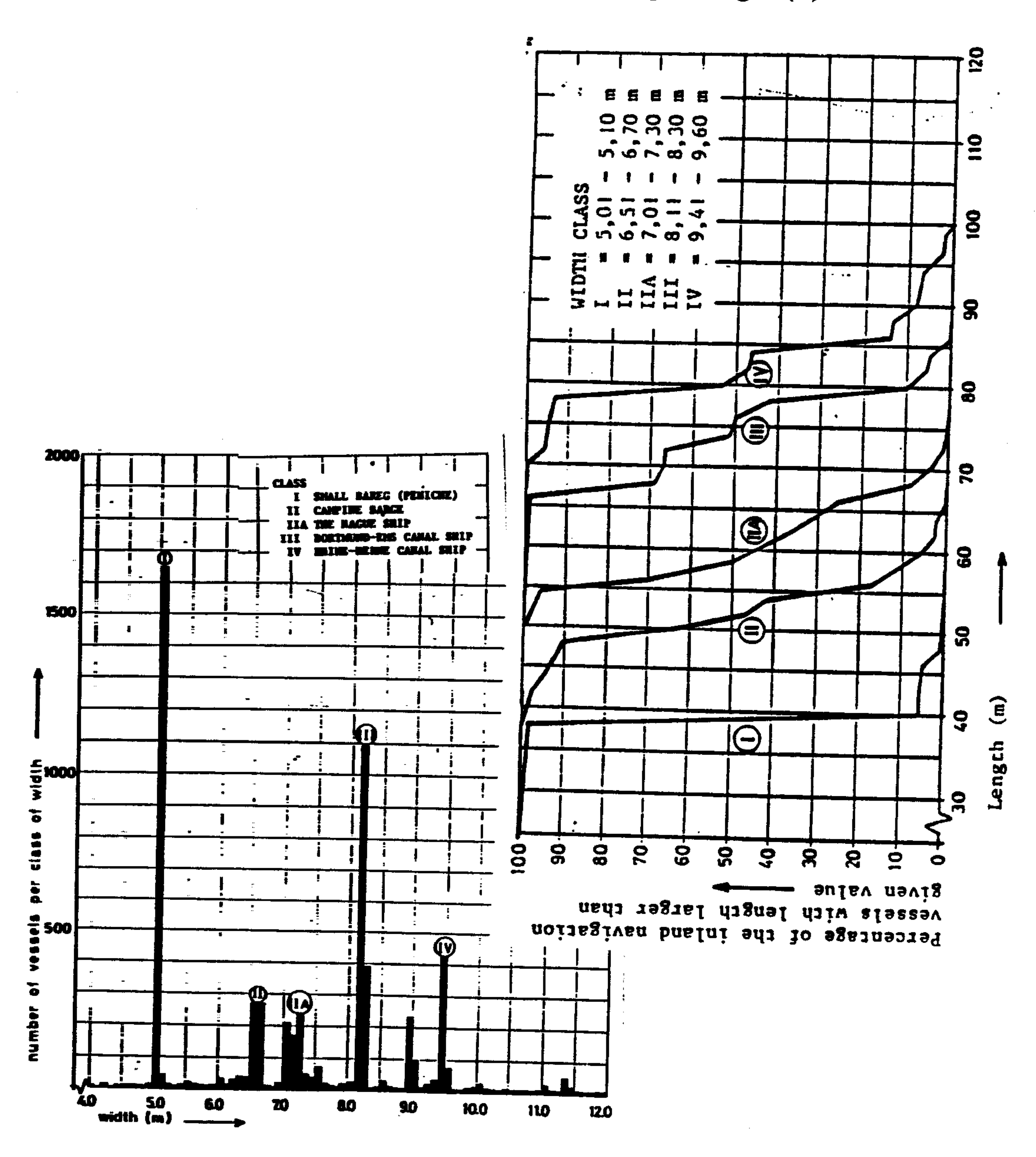


Table 1 shows the standard dimensions for classification recommended by the ECMT, and the dimensions of the design ship which are to be used from now on as the yardstick for the design of waterways and engineering structures in the Netherlands.

Table 1 Design ship dimensions

Class	Type	Carrying capacity (tons)	ECMT classification of ship dimensions				Design ship dimensions for the design of waterways & structures			
			Beam (m)	Length (m)	Height unloaded (m)	Draught (m)	Beam (m)	Length (m)	Height unloaded H_{90} (m)	Draught T_{50} (m)
I	Small barge (peniche)	300	5,00	38,5	3,55	2,20	5,10	39	5,00	2,40
II	Campine barge	600	6,60	50,0	4,20	2,50	6,60	55	6,00	2,50
IIA	The Hague ship						7,20	56 of 67	6,30	2,55
III	Dortmund-Ems canal ship	1.000	8,20	67,0	3,95	2,50	8,20	67 of 80	6,30	2,60
IV	Rhine-Herne canal ship	1.350	9,50	80,0	4,40	2,50	9,50	85	6,70	2,80
V	Large Rhine vessel	2.000	11,50	95,0	6,70	2,70				
VI	Four-barge push-tow unit	10.000					22,80	185,00	8,75	3,90

9.4.3 GUIDELINES FOR THE DESIGN OF CANAL CROSS-SECTIONS CROSS-SECTIONAL DIMENSIONS

The guidelines set out three variants for three different levels of traffic density:

1. Normal cross-section.

In this cross-section two laden design ships are able to meet at speed, and a laden design ship can be overtaken with caution by another such vessel. This cross-section is used where traffic density is high (15,000 passages a year or over) and, wherever possible, on new waterways. It should be seen as the optimum from the navigational point of view.

2. Narrow cross-section

In this cross-section two laden design ships are able to meet with caution, and an unladen design ship can overtake a laden design ship with caution. This cross-section is used where traffic density approximates 5,000 passages a year and in special circumstances.

3. One-way traffic cross-section .

A loaded design ship is able to pass through this cross-section in only one direction. It is used on short waterways with a low traffic density (approx. 1,000 passages a year) and in special circumstances.

Cross-section may be expected to satisfy four requirements:

- The waterway must be deep enough to prevent vessels being difficult to steer or even running aground.
- The water must be sufficiently wide to enable the standard traffic flow to pass safely and speedily.
- Vessels must be able to reach a reasonable speed to keep down the cost of transport.
- The cross-section must not be too large and therefore uneconomical.

Table 2 shows the guidelines, which have been proposed for the design of cross-sections of Dutch waterways. Every cross-section must satisfy all the requirements.

Table 2 Guidelines for the design of canal cross-sections (3)

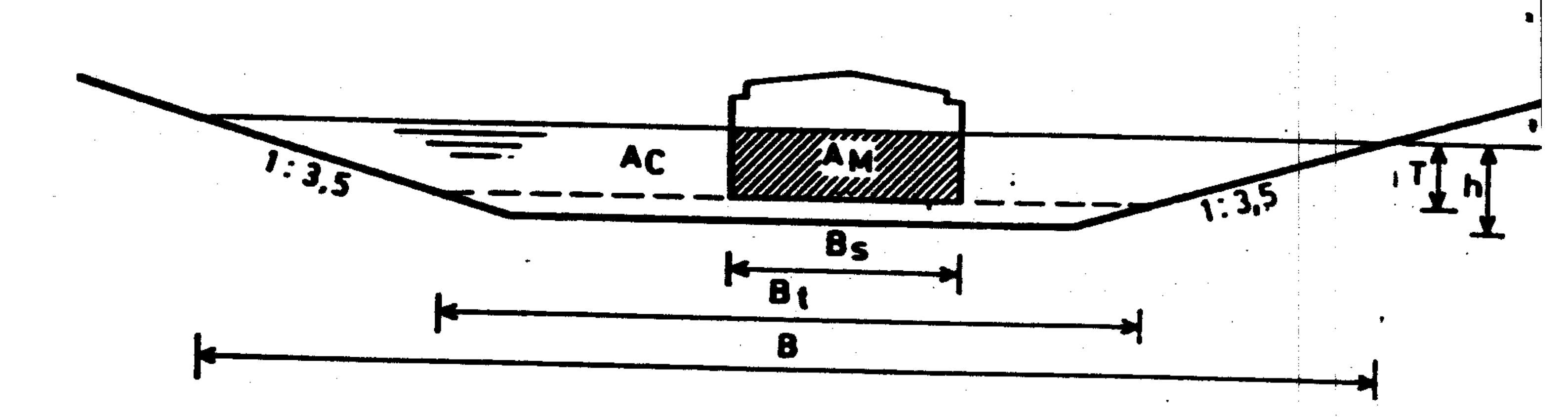
Criterion	Determining	Guideline for		
		normal cross-section	narrow cross-section	one-way traffic
h/T	steerability bed erosion keel clearance	1.4	1.3	1.3
b_T/B_S	meeting and overtaking	4	3	2
V_{max}	maximum speed	2.4-2.8 m/s* (8.5-10 km/h)	1.9-2.2 m/s* (7-8 km/h)	1.4-1.7 m/s* (5-6 km/h)

* The lowest value is for a Class I waterway, the highest for Class IV.

In the above table:

h	- waterdepth
T	- draught
B_T	- width of canal at keel level
B_s	- width of ship
V_{max}	- the maximum speed at which vessels are likely to travel in practice.

Measurements carried out on prototypes indicate that the maximum speed of vessels on Dutch canals is about 90% of the limit speed, calculated according the method of Schijf (4). Higher speeds result in a sharp increase in fuel consumption.



When the guidelines given in Tabel 2 are used to design a cross-section in practice it is not usually possible to satisfy all three criteria 9 h/T, B_T/B_s and V_{max}) simultaneously. Depending on the shape of the cross-section, two of the three criteria are decisive and the third is exceeded. For instance, if the guidelines given in Table 2 are applied to a trapezoid " narrow cross-section " with a slope gradient of 1: 3.5 (see Fig. 9.3), the dimensions will in practice be as follows.

Table 3 dimensions of trapezoid " narrow cross-section" slope gradient 1 : 3.5

Table 3 Dimensions of trapezoid "narrow cross-section"
Slope gradient 1 : 3.5

ECMT Class	Dimensions of cross-section			Values of h/T, B_T/B_s & V_{max}		
	depth h (m)	width at water level B_w (m)	width at bottom B_b (m)	h/T	B_T/B_s	$V_{max} = 0.9\ V_{gr}$ (m/s)
I	3.1	32.0	10.3	1.29	2.98	1.98
II	3.3	37.5	14.4	1.32	3.03	2.06
III	3.4	43.5	19.7	1.31	3.09	2.11
IV	3.7	49.0	23.1	1.32	3.09	2.21

In the literature the ratio A_c/A_m * is often taken as a criterion for the quality of the cross-section. In the case of a trapezoid section with a slope gradient of 1: 3.5 the guidelines given in Table 2 result in the following values for the Ac/Am ratio: normal cross-section $A_c/A_m = 7$; narrow cross-section $A_c/A_m = 5$; one-way traffic cross-section $A_c/A_m = 3.5$.

Width allowance for cross-winds

The width occupied by unladen vessels on a waterway in a crosswind can increase considerably (see Fig. 9.4). Measurements on one of the Dutch canals indicated that the width' occupied by an unladen ship in a side wind (force 7-8 on the Beauport scale) was about three times the beam of the vessel. In a flat, windy area such as the Dutch coastal region proper allowance has to be made for this. On water near the coast with a lot of crosswind (average speed over 4.5 m/s) a width allowance therefore has to be added to the terrain, the predominant wind direction, wind speed and the shape of the cross-section. The maximum allowance is about the same as the vessel beam B.

On waterways further inland no width allowance is generally needed.

- A_c = wetted area (m^2); A_m = area of main frame (m^2).

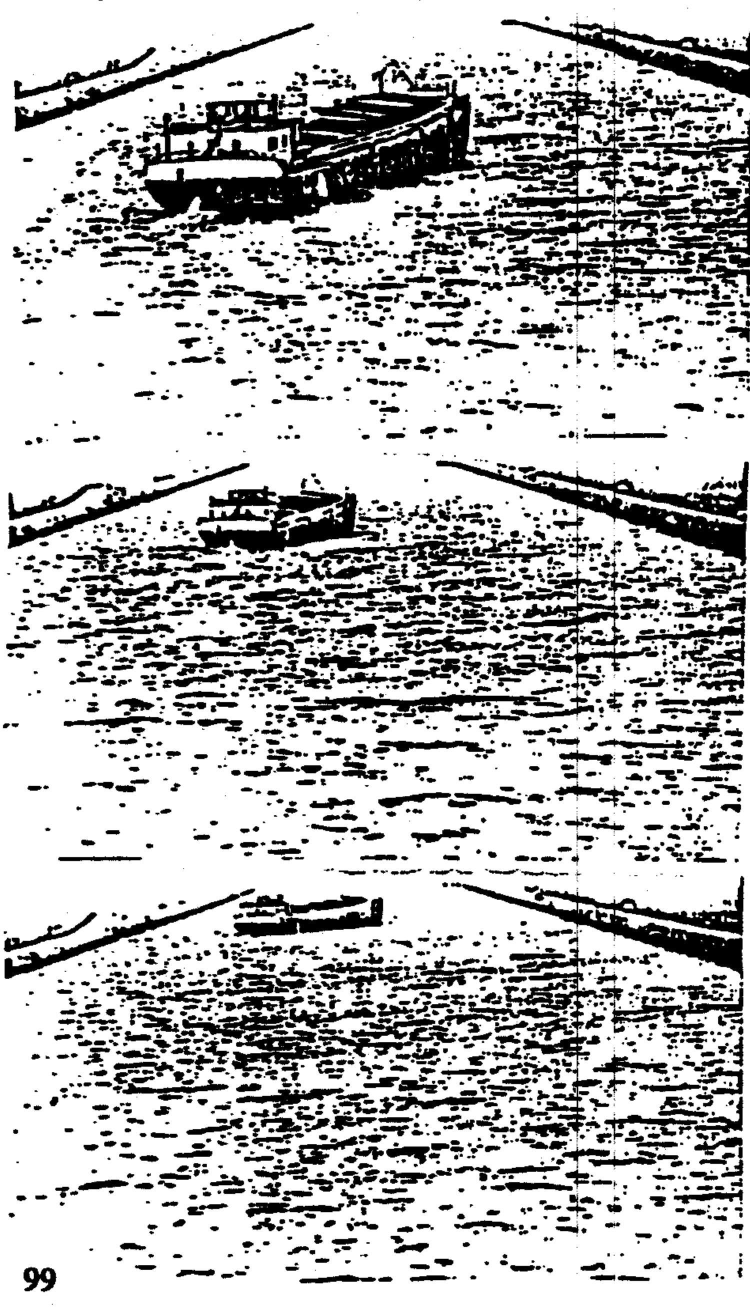


Fig 9.4

Permissible bend radii ; width allowance for bends (5)

There area fairly large number of bends on Dutch waterways where R/L = 4-6 (R = bend radius, L = length of design ship). A smaller radius is possible in principle, but it would entail a considerable loss of speed for vessels on the bend. A minimum value of 4 (narrow) and 6 (normal cross-section) is therefore proposed in the guidelines or R/L.

A vessel occupies a grater width on a bend than on a straight stretch of waterway; consequently on bends a width allowance has to be added to the width guidelines given in Table 2 (see Fig. 13). This is based on the assumption that no overtaking maneuvers will take place, or are permitted, on sharp bends. Unloaded ships take up a grater width on bends than loaded ships and therefore the proposed allowance at the keel level of unloaded ships (b2) is larger than at the keel level of loaded ship (b1). The extra width should preferably be added on the inside of the bend so that two ships approaching from opposite directions can see each other sooner. The guidelines proposed are as follows.

*Table 4 Guidelines for minimum bend radii and width allowances **

	minimum permitted radius	Width allowance on bends	
		at keel level of loaded ships	at keel level of unloaded ships
Normal cross-section	R/L = 6	$\Delta b_1 = \frac{0.5\ L^2}{R}$	$\Delta b_2 = \frac{L^2}{R}$
Narrow cross-section	R/L = 4	$\Delta b_1 = \frac{0.5\ L^2}{R}$	$\Delta b_2 = \frac{L^2}{R}$
one-way traffic cross-section	R/L = 4	$\Delta b_1 = \frac{0.25\ L^2}{R}$	$\Delta b_2 = \frac{0.5\ L^2}{R}$

* In the case of bend radii where R/L ≥10 no width allowance is added.
Where the tangential angle 20°b may be reduce by a factor f = γ /20.

In the above table:

R - bend radius in m
L - length of design ship in m
Δb1 - width allowance at keel level of loaded ships in m
Δb2 - width allowance at keel level of unloaded ships in m

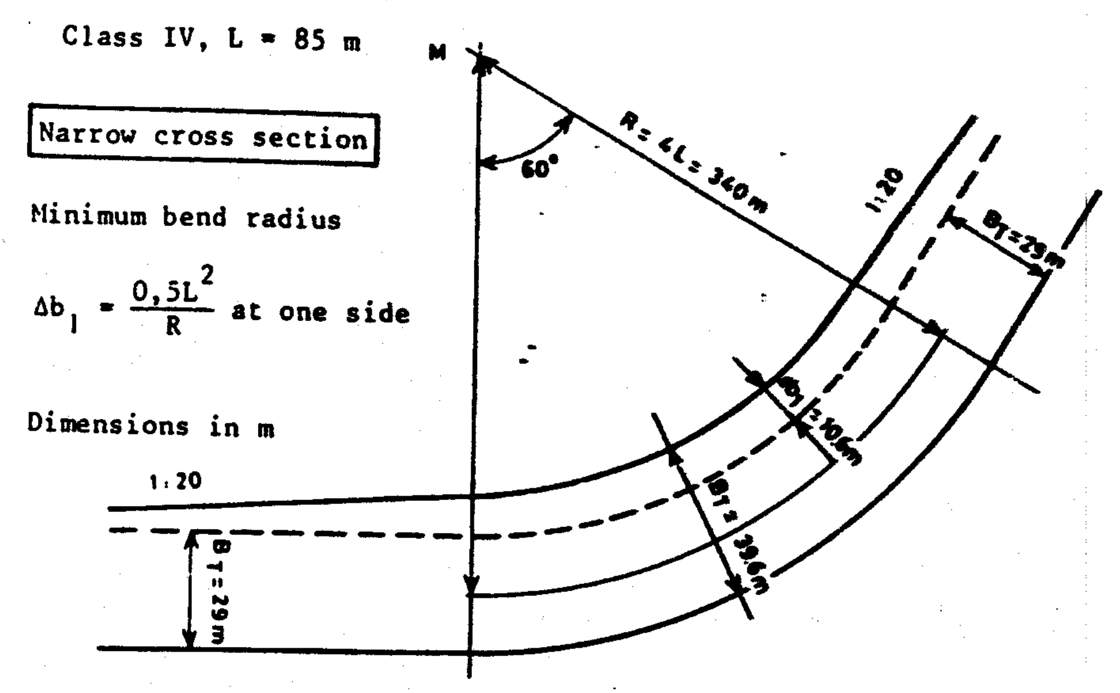
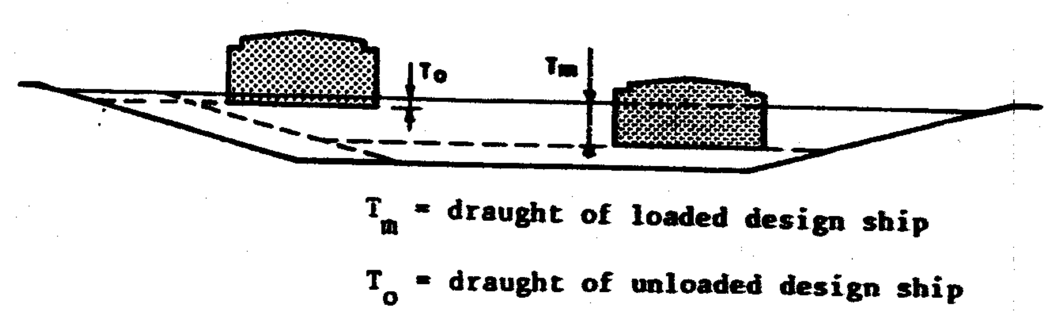


Fig. 13



T_m = draught of loaded design ship

T_o = draught of unloaded design ship

The following comments may be made on the foregoing. The width allowance b2 is greater than ΔΔb1. In a rectangular section this means that Δb2 is always the yardstick. In a trapezoid section there is always more width available at the keel leven of unladen ships than is required by the guidelines given in Table 2, therefore Δb1 is often the yardstick. In the case of a trapezoid section, then, a smaller width allowance will often suffice than in the case of a rectangular section, and this may be one reason for preferring a trapezoid section. It is also true that bank protection is as a rule less expensive with a trapezoid section than with a rectangular section.

9.4.4 LOCKS AND BRIDGES

No guidelines have as yet been draw up for the design of locks. The main guidelines for the design of bridges over canals are as follows.

Table 5 Guidelines for the design of bridges (6)

Class	Dimensions of design ship		Fixed bridges Recommended min. passage height (m)	Movable bridges. Recommended min. passage width* (m)
	Beam B_s (m)	Height unloaded H_{90} (m)		
I	5.10	5.00	5.30	7.00
II	6.60	6.00	6.30	8.50
IIA	7.20	6.30	6.60	9.50
III	8.20	6.30	6.60	10.50
IV	9.50	6.70	7.00	12.00

* A larger opening may be required if shipping density is high or if the bridge opening is not in a direct line to the waterway axis.

The recommended passage width is based partly on a cost-benefit analysis taking into account not only the investment cost but also the cost of loss of time to shipping and road traffic.

In the case of movable bridges with the recommended passage width, expeditious traffic flow, especially if there is a good deal of cross-wind , requires a simple entrance structure (gradient 1 : 6 to the waterway axis or less ; see [6]) .

If a lot pleasure craft uses a waterway it is often advisable in the Dutch situation to make movable bridges high enough to enable most motor yachts to pass without opening the bridge.

9.4.5 THE SPACE AROUND THE WATERWAY CROSS-SECTION

For various reasons it is not advisable to have buildings close to the banks: Table 6 gives the guidelines. These allow for an unrestricted visibility of 5 L. The height of the buildings should be no greater than the distance from the bank.

For reasons of safety the minimum height for high - tension cables is considerably greater than that for fixed bridges. Table 6 also gives guidelines for these, making allowance for pleasure craft with sails , floating derricks e.g.

If there is insufficient ground cover over cables and sag pipes they can be damaged by ships' anchors a dredging work. Table 6 gives guidelines for minimum ground cover based on the depth to which maintenance dredging is carried out. The values given are inadequate, however, if the soil is very

soft. Allowance must also be made for fluctuations in ground level in rivers and other watercourses.

Less cover may if necessary suffice in the case of tunnels provided the roof of the tunnel is strong enough; in this case it is not possible, however, for ships to anchor over the tunnel.

Table 6 Space around cross-section

Waterway class	Min. distance to buildings		Headroom under high-tension cables		Min. cover for cables & sag pipes	
	Rural areas (m)	Urban areas and canal-linked industry (m)	Without sailcraft with fixed bridges (m)	With sailcraft & movable bridges (m)	Nominal	For mains and near bridges & locks (m)
I	15	10	20	30	1	1.5
II	20	15	25	30	1	1.5
III	25	20	25	30	1.5	2
IV	30	20	25	30	1.5	2

CHAPTER 10

10.5. LESS DEVELOPED WATERWAY SYSTEMS

10.5.1 CHARACTERISATION OF A LESS DEVELOPED WATERWAY SYSTEM

A sharp distinction between a developed and a less developed waterway system does not exist. However, less developed systems frequently how the following characteristics:

- Quantities of goods transported via the waterway system are often much smaller than in the case of a developed system, and because of the natural conditions, transport will fluctuate during the year as a consequence of varying and sometimes insufficient water depths.
- Rivers are often braided and the best channel is not properly defined; channels rapidly from day to day.
- The system consists of natural waterways such as rivers and lakes which are not or only to a small degree improved, in other words, no normalisation, canalisation, regulation of discharges and water levels;
- Availability and reliability of data is much lower than in developed countries.

10.5.2 APPLICATIONS OF THE "PLANNING PROCEDURE "

In principle the logic framework as has been presented in chapter 2 can be applied to a less developed waterway system.

Due to scarcity of technical and economical data, improvement, design and further data collection often run parallel, rather than in sequence, forcing the use of the logic framework with insufficient and unreliable data. Therefore the data available should be used with creativity.

After an analysis of the existing system, the first step in improving an inland waterway system is normally the set-up or improvement of a signalling system and patrol services. For a proper functioning of this system technical data on water levels, discharges and other river

characteristics, and economical data on traffic data on traffic, cargo flows, etc. are required to enable optimum use of the existing waterway system. Thereafter, a more regular navigation on inland waterways implies a regulation of navigation conditions, which often means an increase of the least available depth (LAD).

Since in developing countries, it often takes time before a strong increase of cargo flows has been reached, economic justification requires that large capital investments are avoided.

Cheap construction methods and materials are the only way to keep investments low in this phase of the project. Sometimes, besides the cargo flows, transport of persons may justify a project.

Because of the feasibility of improvement works only at low cost, the possible alternatives are limited and, in general stages 8 to 14 of the "Planning-procedure" being the evaluation and optimization of economic and technical details of the alternative solutions, are more easily executed without having to enter into too many details.

Measures to be taken during and after implementation of the improvement works (stage 16) are very important when dealing with a less developed waterway system. Maintenance of the river improvements, set-up of a maintenance organization, collection of technical and economical data are items which require full attention since these aspects until then were regarded as relatively unimportant, and it, therefore, implies a change in mentality of waterway agencies.

Finally for the analysis of cost benefit ratios the same uncertainty of figures is present as for the economic evaluation and traffic flows.

10.5.3 CHEAP IMPROVEMENTS METHODS

Improvement of inland waterways in less developed countries, which normally consist of a river system, generally is realised by an increase of the least available depth.

Recurrent dredging

With the necessity of only small investment costs at the first stage of improvement of an inland waterway system, recurrent dredging often is a good solution.

The least available depth in a river is at a "crossing", where the talweg changes from riverbank. Streamlines diverge due to a larger width and

consequently shallower depth results. The dimensions of a crossing determine which least available depth changes with varying water levels in the time.

Recurrent dredging of the worst crossing in a river can increase the least available depth in this river. Thorough knowledge of the behaviour of the crossings is necessary as well as accurate prediction of the depth in the crossing after dredging.

Only then can a dredging programme be established which can guarantee a certain minimum depth during the year.

An example of such an improvement method is the River Niger in Nigeria between lokoja and the seaports in the Delta, some 700 km away. In 1977 a consortium (NEDECO as consultants and Boskalis dredging contractor) was awarded a two years contract to design and execute such a dredging programme. The criterion which had to be fulfilled was a LAD of 1.5 m for 10 months of the year for a minimum discharge of 1750 m3/s which roughly meant an increase in depth of 0.25 m. Transport on the river at that time was minimal being only transport of general cargo for the purpose of contractors, and passengers with small ferry boats. Because of a steel mill under construction in Ajaokuta near Lokoja, transport of bulk material is expected in the future.

An inventarisation of the river stretch by studying aerial photographs and executing hydrographic surveys at around 45 locations showed that approximately annual dredging.

The depth in a crossing is influenced by the phenomenon retarded scour. Due to the large width of a crossing in comparison with the width in a bend, a crossing sediments during high stages and scours during low stages. As a function of the morphological reaction speed of the river, there will be a time-lag between the sedimentation and scour compared to the change in water levels. That is why the name reacted scour is introduced.

In a mathematical model the behaviour of a crossing can be simulated.

In Figure 14 the computed retarded scour for the Atani/Goma crossing in the Niger is shown and it can be seen that a maximum sedimentation occurs of 1.5 m during high water stages.

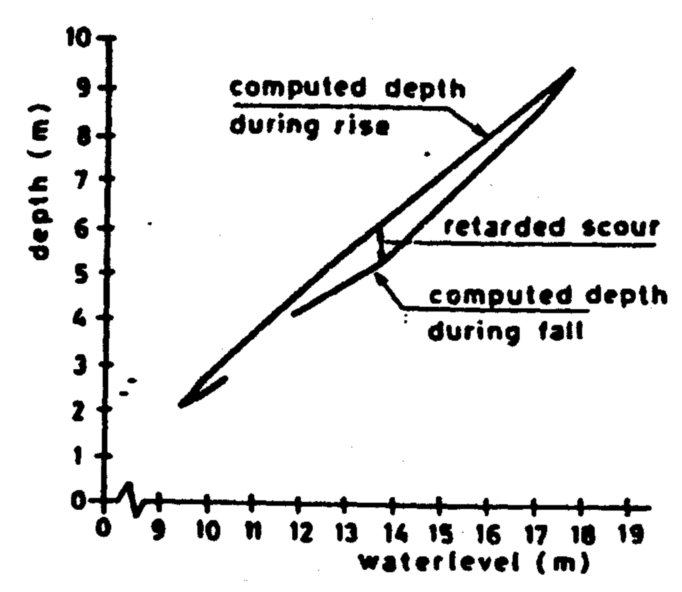


Fig. 14

Fig. 14 : COMPUTED RETARDED SCOUR; AZAGBA

With the results of these computations quantities to be dredged can be predicted and a dredging programme and organisation be set up. For the season ' 78 - 79 'in total a quantity of 1.5 million cubic metres was dredged with four dredgers. Specifications of dredgers and the realised productions are stated in Table 7.

Table 7: Specifications of Dredging Programme 1978 - 1979 Low Water Season.

Name	Pump Power (hp)	Diameter discharge (m)	Volume removed (m3)	Average weekley Production (m3)
W.D. Benin	765	0.40	384,000	24,000
W.D. Gouwe	900	0.45	256,000	15,500
W.D. Volte de Lomé	1165	0.45	715,000	39,500
W.D. Alexa	500	0.32	161,000	22,500

The amounts of material dredged are in the same order of magnitude as the natural bed material transport of the river. The spoil should therefore be dumped again in the river to avoid large changes in river slope. Suitable dumpsites can only be determined by a study of the bed configuration and the flow lines.

Use of cheap construction methods and materials

Another method to keep investments low in the first stage of improvement is to use cheap construction methods and materials. A recent example of such a method is the construction of " beaver " dams and groynes in the lower Sangha in Congo.

The lower Sangha river is the main transportation route for the down-stream transport of wood in the form of rafts and on barges and the upstream transport of cargo on barges between Brazzaville in the South and Ouesso in the North. The existing road between Brazzaville and Ouesso is only accessible during the dry season and the main transport; the logs of wood cannot be transported on the road at all.

Because of insufficient depths on the lower Sangha during low water stages, during a certain period of the year only restricted navigation is allowed (with restricted depths and dimensions of rafts). Sometimes during a number of months transport does not exist at all.

To improve the navigation on the river a normalisation should be realised by restricting the width of the river from an average 700 m to approximately 500 m thus gainging a depth of 0.40 m. The restriction in width is realised by closing secondary channels by beaver dams and by groynes in the main channel.

In 1981 the river section km 434 - 440 of the lower Sangha was chosen to experiment improvement with the method of beaver dams and groynes. Three dams and one groyne were designed to obtain the normalised river conditions for this section of the river and in the summer of 1982 these structures were constructed, see Figure 15. In this figure alignment of the channel has been indicated. This alignment should be considered as a masterplan in which all works executed should fit, not as something to be obtained within a short time.

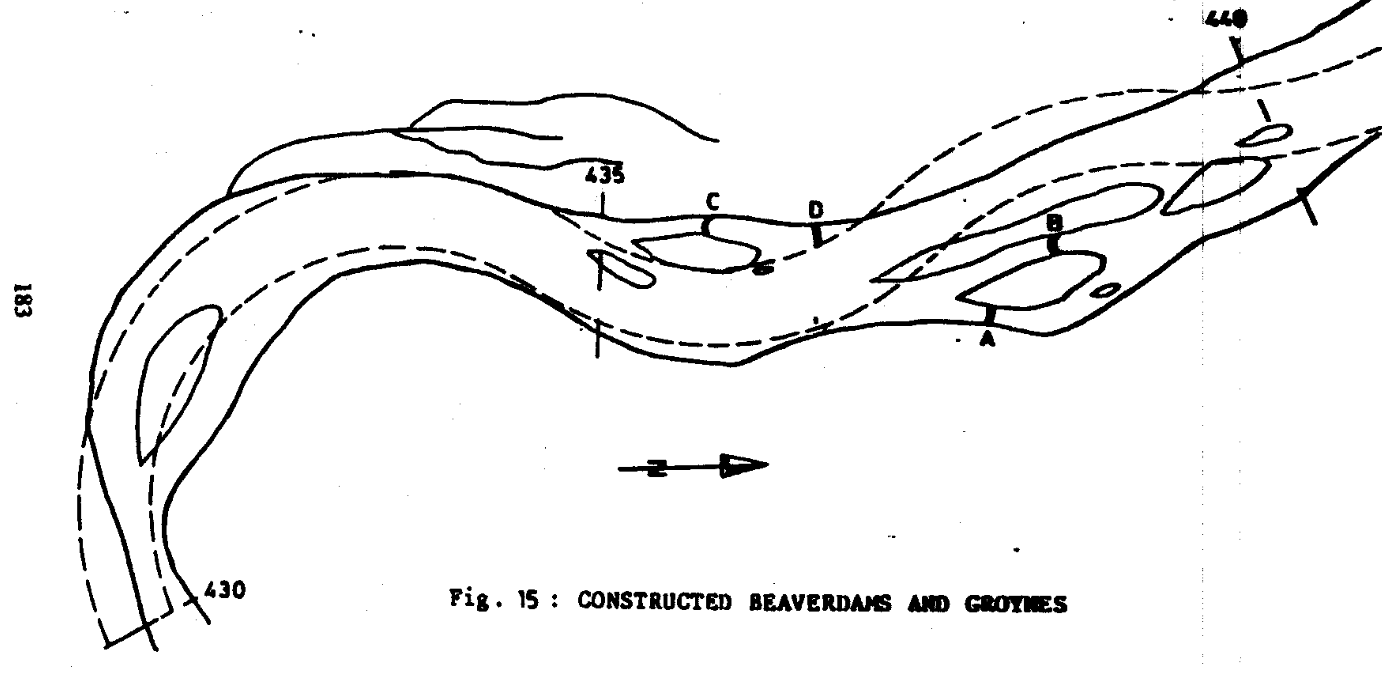


Fig. 15 : CONSTRUCTED BEAVERDAMS AND GROYNES

Fig. 15

The body of the beaver dams and groynes consist of trees, with branches leaves, lianes etc., kept together and in position by cables for the dams and vertical rails for the groyne (see figures 16 and 17).

RAILS
RIVERFLOW
top view
CABLE
FLOW
RAILS
cross section
BEAVER GROYNE

RIVERFLOW
LARGE TREE
top view
CABLES
FLOW
cross section
BEAVER DAM

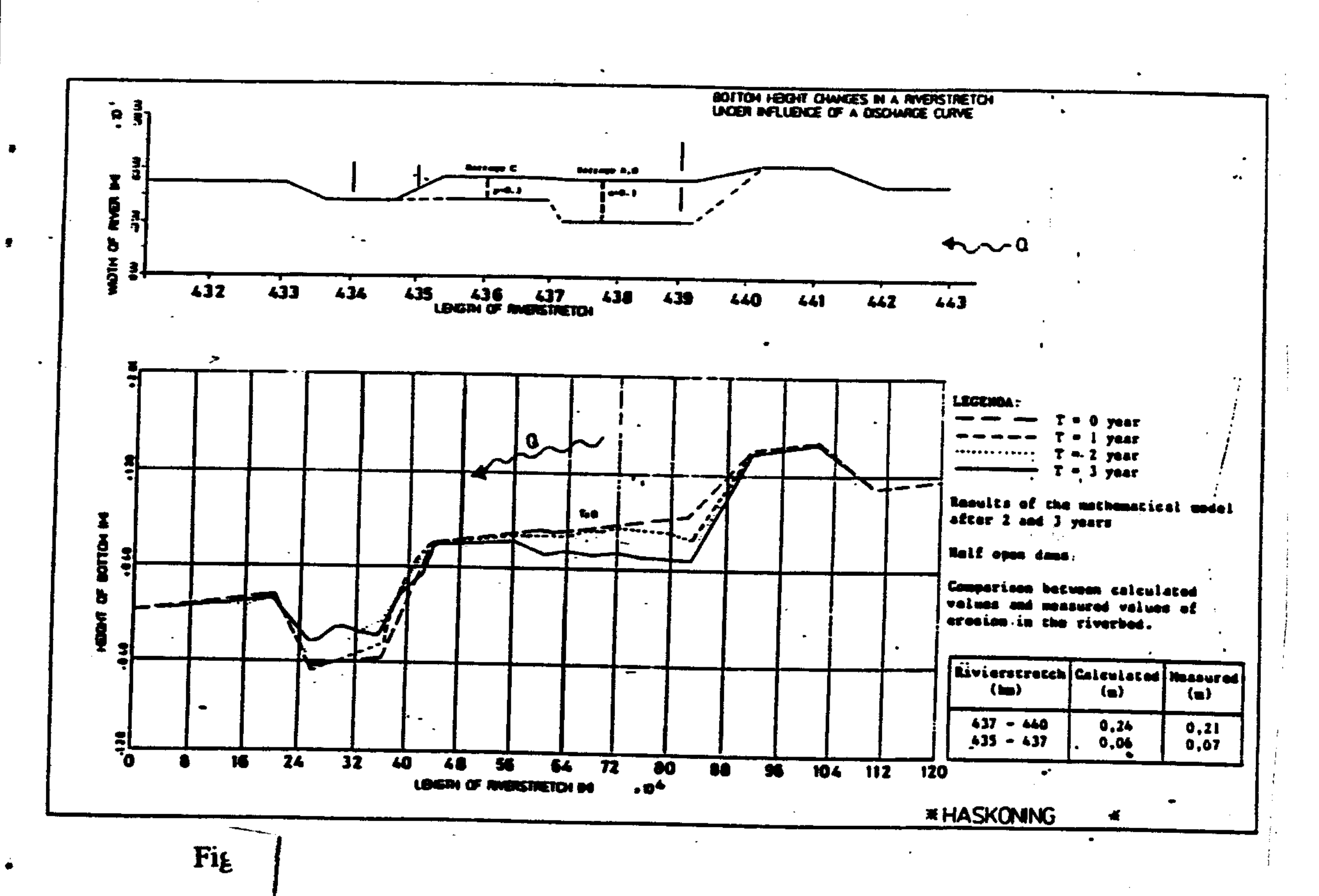
Fig. 16: BEAVERDAM AND GROYNE

Fig. 16 And 17

The same mathematical model as mentioned before was adapted to compute the effects for this particular problem of half open dams and groynes with a crest level lower than high water level.

Results of the mathematical computations after several years are shown in figure 18.

An erosion of the existing bed level occurs in the open channel opposite of the dams while at the downstream end of the river section sedimentation occurs. Both erosion and sedimentation progresses downstream. The sedimentation does not pose serious problems due to the existing deep bed level downstream while after some years erosion of the navigation channel has progressed to the downstream end of the river section.



Rivierstretch (km)	Calculated (m)	Measured (m)
437 - 440	0,24	0,21
435 - 437	0,06	0,07

Fig

In the summer of 1983 measurements at the site confirmed the result of mathematical computations, and moreover the constructions had remained stable and effective after the high water period of 1982.

In table 8 costs of improvement works with recurrent dredging and with beaver dams and groynes are compared with conventional improvement methods consisting of rock dams and groynes. The actual amount per km of improved river depends upon local conditions and the required improvement level.

Table 8 : Comparison of Costs for Alternative Improvement Methods.

Type of river improvement	Annual costs for 100 km (x10 6 USS)
Conventional method	20 - 40
Recurrent dredging	2
Beaver dams and groynes	0.5

CHAPTER 11

11.1 The Container Revolution

On April 26, 1956 a converted tanker, carrying 58 trailer vans on its specially adapted decks, sailed from Newark, New Jersey to Houston, Texas-touching off the container revolution. From this experimental jury-rigged beginning, one of the most fundamental and far-reaching advances in the history if intermodal transportation took shape and expanded to major U.S. shipping routes, and to routes throughout the world.

11.2 A Commercial revolution

Achieving smooth onward movement of cargo at the land-water boundary has been one of the greatest challenges in intermodalism. Consequently when it was publicly demonstrated in 1956 that standard containers could move goods successfully on a land-sea intermodal journey, a commercial revolution was started.

The revolution was properly dubbed the " container " not the " intermodal " revolution, because it was the container's unique role as common denominator among modes that was revolutionary.

11.3 A new Sub-industry

As a result of the container revolution, the container manufacturing and service industry emerged as a new sub-industry. Container leasing, maintenance, and repair have become important businesses. Containerports, each with hundreds of acres for assembling thousands of containers, have grown into separate independent facilities at many maritime gateways. Cranes, transporters, and other container-handling devices represent big business for heavy equipment manufacturers, and multimillion dollar fixed investments for ports.

11.4 Guiding Hand of Malcom McLean

Trucking executive Malcom McLean is the one person most responsible for the container revolution. Using the operating rights of Pan Atlantic Steamship Corporation as his medium, Malcom McLean guided the initial 1956 sea-land experiment. The service was successful from the beginning.

At the outset it used two converted tankers, each with a capacity of 58 20-foot containers. The fleet was soon expanded by two more converted tankers.

In 1967, the company took delivery of the first ten containerships,each with a capacity of 226 35-foot containers and ship-mounted cranes. Pan Atlantic's name subsequently changed to Sea-Land Services. Today, Sea-Land Services is one of the world's largest containership lines.

Although ocean carrier managements were well aware of the technical feasibility of loading land containers on decks of sea-going vessels, they were reluctant to adopt the practice because it interfered with their preconceived notions of how shipping ought to work and with habits and procedures that had evolved over centuries.

McLean had the courage to buck prevailing wisdom ; he had the ingenuity to improvise with modified tankers ; he had the foresight and ability to offer an excellent standard of service that brought shipper acclaim ; and above all, he had a showman's sense of timing and public relations. He issued a press release referring to the voyage as an " experiment in integrated truck-ship freight distribution " and as the inauguration of a "land and sea tanker trailer system." The success of the venture and its favorable publicity made the container revolution come about when it did.

11.5 Prior intemodal exchanges

Several intermodal container efforts preceded McLean's breakthrough.

As early as the late 1920s, intermodal container services by land were operating within the United States. Although truck-trailer van shipments by rail had been made, they ran into difficulties with Interstate Commerce Commission (ICC) rate regulations. Nevertheless, trailer-on flatcar (TOFC) and container-on-flatcar (COFC) services had commenced, and were increasing in frequency.

In 1929, Seatrain Lines fitted rails on the decks of several ships. These ships operated between the United States and Cuba, shuttling trains between each country's rail systems. When U.S.-Cuban trade was severed in the early 1960s because of political tension, the ships were palced on the U.S. Puerto Rico run, but were not successful because of the inadequacies of Puerto Rico's rail system. Seatrain switched to a standard containership system on the US-Puerto Rico run following McLean's successful experiment.

The Alaska Steamship Company began operating vessels, each accommodating 90 truck-size vans between Seattle and Seward in 1953. This remained a specialized, low profile service confined to the Alaskan route.

And, during the 1950s, the Bowling Green Storage and Van Company of New York offered a transatlantic "Lift-van" service for moving household goods and specialized commodities.

11.6 Subsequent Containership Services

The first two-oceanborne container runs instituted after the coastal services of Pan Atlantic were between the U.S. mainland and two of its island domains. Sea-Land Services operated the New York-Puerto Rico run while the Matson Navigation Company operated the U.S. West Coast-Hawaii route. These two mainland-island container services were inaugurated almost simultaneously in August 1958. The first international container service was inaugurated by Grace Line in 1960, between the U.S. East Coast and points in the Caribbean, Central and South America.

From 1960 to 1965 U.S. containership capacity on coastal and mainland-island services expanded with the addition of newly constructed containerships and conversion of other ship types, such as break-bulk vessels and tankers, into containerships.

11.7 Containerizes but not infermodal

The first decade of the container revolution constituted mostly just that-a container revolution, with few land-sea intermodal aspects.

Matson Navigation Company's *Hawaiian Merchant*, a converted C-3 freighter, sailed out of San Francisco Bay for Honolulu, Hawaii, August 31, 1958, with 20 containers stowed on deck. This was the inaugural sailing

of Matson's U.S. West Coast-Hawaii container service, the first container route in the Paciffic.

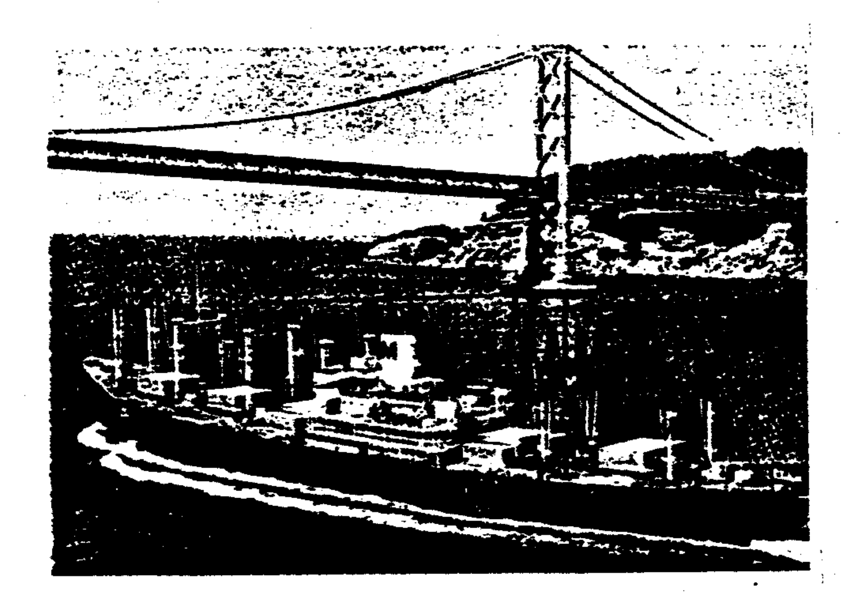


Fig Without No.

Source : R.J. Pfeiffer, Transport 2000, May / June 1981.,p. 36.

Intermodality was confined primarily to local pickup and delivery of containers by trucks. Competitive animosity between land and sea modes, combined with institutional lethargy, caused land-sea intermodality to progress slowly.

An August 1963 article in Via Port Stated :

> Since the railroads were transporting thousands of highway trailers, it was reasonable to expect they could haul trailers bound for Europe and other distant markets. Yet, today, coordinated transport for export shippers stops at the waterfront for the most part. At best, international coordinated transport is available in diluted form on a wide basis and in a pure form on a highly restricted basis.

Highway trailers filled with exports arrive at the Port of New York daily after a TOFC haul just as do thousands of trailers driven over the road. However, the TOFC trails like the others are unloaded at truck terminals, railroad pier stations, or on steam-ship piers, but hardly any go overseas intact. One step closer towards integrated transport are those TOFC trailers reaching port with smaller containers filled with exports ready to go aboard ship. Grace Line the one international containership operator on the Atlantic

Ocean, has planned with a domestic freight forward to have Grace "Seatrainers" for Venezuela moved overland by a joint truck-rail haul from Midwestern points to the Port of New York.

In spite of the forwarder's published tariff and other preparations, no vans have moved under the truch-rail sea arrangement.

States Marine-Isthmian vessels, operating to most of the world's major markets, offer the closet approach to international integrated transport. The line has pacts with the New York Central Railroad Flexi-Van system and Xtra, Inc. Both make the 20-foot long units available;

Flexi-Vans (sea-van type are owned by the ocean carrier and exchanged with the railroad, while Xtra makes vans available to States Marine on a per diem basis. Two major U.S.-flag lines have recently requested bids from various trailer manufacturers for prices on large orders of 20-foot long vans.

11.8 First Transatlantic Containership operations

In early 1956, Sea-Land launched the first transatlanic containership operation with service from Port Newark toRotterdam, Bremerhaven and Grandemouth. The company was soon joined by U.S. Lines. Most other transatlantic, as well as operators on routes to japan and Mediterranean ports, showed great ambivalence. Some experimented by stowing containers on decks of conventional cargo ships, while others made mild modifications to their vessels, and still others ignored the possibility of carrying containers. any were slow to adapt to the efficiencies of the container revolution. Their delay is attributed to indecision and failure to recognize the advantages. Indecision was fostered by several obstacles, makin the choice an exceptionally difficult one for ocean carries.

Investment Required.

A major obstacle was the large capital investment in containerships, containers, and terminals required for containership operation. Cost savings could not be realized simply by loading containers, like any other pieces of cargo, on breakbulk ships. As the industry advanced, full cost savings could be achieved only through uncompromised containership operations.

No Subsidy Containerization.

The federal subsidy program did not encourage U.S. Ocean carriers to make capital investments for profit enhancement. Additionally, the U.S.

shipbuilding subsidy program was based on potential ton-miles produced per dollar spent, rather than on operating efficiency or profitability of ships produced.

As a result, the program continued to crank out obsolete breakbulk vessels long after the container revolution had proved its point. Furthermore, The Defense Department and Military Sea Transport Service (MSTS) frowned on the proliferation of containerships because they felt they were not as flexible for wartime use as breakbulk or ro-ships.

Labor Union Objections.

Labor unions did their part to slow containerization progress because they were afraid it would mean loss of jobs for longshoremen. As a result, excessive labor rates and practices were incorporated in labor management agreements. Some labor agreement provisions were viewed as penalties rather than incentives because of containerization's perceived threat to labor.

Conferences Unprepared.

Conference carries had insulated themselves from new ideas. They operatedon a subsidized basis within a share-of-market allocation system for many years. Since they had dispensed with research and planning departments, they did not have an internal alarm system to alert them to the need for change.

Fast vessel turnaround in port, an outstanding benefit of containership operation, is diluted if the containership stops at too many ports of call. Smart containership operators today limits the number of pots of call through " loadcentering." They funnel freight through just a few major ports, and serve other ports by local land or sea connecting carries. In the 1960s, the loadcentering concept would have altered the conferenc's established share-of-market allocations, pitting conference members, as well as non-conference carriers, against each other in an unwelcomed competitive struggle.

Additionally, the conference ratemaking system was based on commodity rating, which allowed the conferences to set prices on the basis of " what the traffic will bear." They charged high rates on certain commodities where possible, and permitted lower rates on other commodiries where necessary to induce traffic to move. Containership pricing, by contrast, is based on flat

per container or per ton rate in most cases, regardless of the commodities inside the containers. Because conference carries felt their margin of profit came from high-rated commodities,

it was difficult for them to accept the possibility that lost revenue from this source would be offset by containership operating efficiencies.

International Complications.

Although containerships had operated successfully on coastal routes, complications existed in the international arena, making many ocean carries hesitate to adopt the containership approach. There were differing load and size restrictions for inland road and rail transport in foreign countries, and customs officials took varying approaches to container clearance. Some international ocean carrier management's did not understand that these practices eventually would become more uniform.

After Sea-Land's transatlantic containership introduction, great turmoil ensued among U.S. and foreign-flag shipping lines on most major routes.

Some adapted to the changing environment by establishing new methods and new vessel configurations. Others joined together in consortiums for extra support. And, still others were absorbed or defaulted because they were unable to adapt to the changing conditions.

11.9 Entrance of Foreign Operators

Until 1966, containership operation was primarily a domestic phenomenon operated by U.S. carriers. Several foreign shipping lines soon recognized the efficiencies of container operation and joined the new wave so as not to be outmoded. Consequently, after Sea-Land invaded the North Atlantic with containership operation in 1966, foreign carriers began joining the bandwagon by instituting containership service on major trade routes.

11.10 Containers Take over Transatlantic Breakbulk

By 1973, transatlantic trade consisted almost entirely of cargo carried by containership and roll on-roll off (ro-ro) vessels exccept for bulk cargo in bulk cargo ships. Breakbulk vessels were almost completely squeezed out of the transatlantic market, except in certain cases where size and other characteristics of the cargo did not conform to standard container sizes.

11.12 Diminution of U.S. Share of Market

Although some U.S. companies continued to maintain a good growth rate, America's share of containerized trade decreased as more foreign companies entered the field. The entrance of foreign companies affected the U.S. share in three industries- containership operation, shipbuilding and container construction and leasing.

Efforts to Save U.S. shipping and Shipbuilding.

There have been many losses, failures and takeovers of shipping and shipbuilding companies. Congress has been designed by lobbyists, and the media has carried many articles decrying the decline of U.S. shippingand shipbuilding industries. Demands to save the industries have been loud, calling for legislation to protect the industry from " unfair " foreign competition.

Government Intervention:

Pro nd Con. Arguments in favor of legislative action to protect and subsidize U.S. shiplines and shipyards stress that many foreign shipping and shipbuilding companies are subsidized, that foreign crews and workers are paid substandard salaries, and that in terms of defense, America needs a strong merchant marine and shipbuilding industry.

Subsidy opponents question whether taxpayers should contribute to keeping selected private companies in business. They believe the result is the same as erecting trade barriers in any industry: protection of inefficient producers and high prices for consumers. Opponents allege that the more protection U.S. shipping and shipbuilding are given, the more outmoded and inefficient they become. They believe that the more successful U.S. companies are the most innovative and the least dependent on government help.

ICC and FMC Controls.

The U.S. government through regulatory agencies also slowed progress of the container revolution and land-sea intermodality. The ICC and the Federal Maritime Commission (FMC) each in its respective sphere of land and sea, exerted, in varying degrees, tight control over rates and conditions of carriage. Such rigid government control over prices and conditions discouraged a more rapid development of land-sea intermodality. In subsequent years the ICC and FMC expended considerable effort to

coordinate their rates and other policies, and to promote land-sea intermodal cariage (see Chapter 4).

Foreign Government Regulations.

Other governments are involved in maritime regulation, affecting the United States in international trade. Their tendency generally has been to protect the status quo, although that protection varies considerably between nations.

Ocean Carrier Conference System.

Another protector of the status quo is the ocean carrier conference system. The FMC encouraged U.S. conditions of carriage. Initially, the FMC assessed heavy fines on U.S. and foreign-flag carriers for setting rates outside the conference machinery, but has since eased its controls and policies in line with overall U.S. deregulatory trends. Deregulation, however, has not progressed as farin ocean shipping's it has in other modes. Maritime legislation adopted by Congress in 1984 takes an ambivalent attitude toward the ocean conference system.

In more recent years, non-conference carriers established intermodal rates to interior points, known as microbidge or interior-point pricing.

These rates were often lower than port-to-port conference rates. Conference members were forbidden to file similar rates both by their conference agreement and by FMC enforcement of their conference agreement. For a while this crisis threatened to demolish the conference system on routes to and from the United States.

The situation was eased by FMC approval of conference agreements to set through intermodal rates to interior points and by the fact that some outsiders eventually joined the conferences. (This situation is dealt with in more detail in Chapter 5, sec., titled *Competitive Stir and Turmoil.)*

11.13 Impact of the container revolution

The maritime industry's history is not a straightforward one of simple and direct competition among independent participants. Instead it has been affected by governments and conferences. The container revolution created more competition for the maritime industry. The overwhelming efficiency of containership operaton forced many shiplines to convert to this more efficient system, move on to other trade routes, or perish, despite the helping hand of government regulation and subsidy or of conference protection.

11.14 Containership Operators

Over the years, many U.S. shiplines have been absorbed (American Export, Bull, Grace, isbrandtsen, Pacific Far East and States Marine) or gone bankrupt (Seatrain, U.S. Lines). Sea-Land, one of the largest single containership operators in the world, is still a U.S.-flag carrier. American President Lines, although not as large as Sea-Land, remains a leader in intermidalism. U.S.-flag carriers are not the only ones that have had to recoganize andregroup under the prod of stiffer container-era competition. Foreign-flag carries have gone the same route. Atlantic Container Line (ACL), a major European transatlantic containership operator, is a consortium of six European lines design to cope with the new environment. Today, the U.S. share of the business has dwindled and a number of its companies have disappeared. Only a fewu.s. interests including Sea-Land and American President Lines command a respectable market share.

11.15 Container Construction and Leasing

A similar situation has occured in container construction and leasing. Prior to 1966, U.S. companies practically monopolized the market. Increasing numbers of foreign companies have now entered the business. The U.S. share of the container construction and leasing market has declined, but a U.S. company-Genstar /Gelco CI Container Corp.- still dominates the feild. Five of the nine largest container construction and leasing companies are U.S. companies.

Intensified Competition in Shipping and Ship Construction

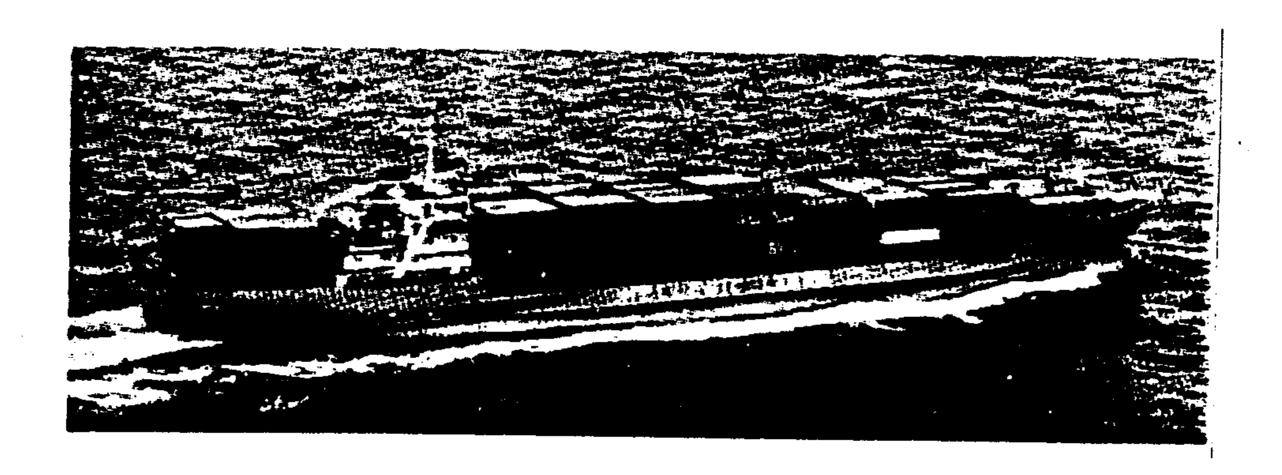
Use of containers to transport general cargo aboard ocean-going vessels produced such a fundamental improvement in shipping operations that it spawned numerous additional innovations. Not only did it cause realignment and regrouping of carriers on major routes, but it permitted carriers with containership efficiencies to invade new routes.

The container revolution generated more competitive vessel designs, and it caused shipowners, especially in the earlier years, to become creative in converting tankers and freighters into containerships. A later, more sophisticated idea was to " jumboize "vessels by increasing ship capacity anywhere from 25 to 60 percent. Containerization led to innovative ocean vessel operations like containerization in connection with ro-ro and lighter aboard ship (LASH) operations. By marking intermodal transfers easier, containerization also made a broader array of new intermodal routing and

pricing options available to shippers. For example, an inland U.S. shipper transporting goods to an inland European destination was given literally thousands of new routing and pricing options. In turn, the competitive struggle among carrioers for the shipper's business intensified to the benefit of shippers.

11.16 Major Outside Influences

During early years of ocean containerization, competition existed between only a few established and new entrant carriers. In the 1970s and early 1980s, containerization operations (as well as transport operations in other modes) were subject to four major outside factors that greatly affected their fortunes and the way in which they conducted bussiness



Many ship owners have converted tankersand freighters, such as the freighter conversion shown here, into full containerships.

Source: Traffic World, October 3, 1983, p. 82.

The influences were :

(1) tenfold increase in fuel prices, starting in 1973 ;

(2) deregulation in the United States, starting in 1975 ;

(3) changing world trade patterns ; and

(4) better understanding of logistics management.

Fuel Price Increase.

During the 1970s, fuel price increases madeit necessary to hike shipping rates in successive steps commensurate with each fuel price jump. Increased fuel prices also were supported in part by charging shippers a fuel surcharge based on a per ton cargo rate that fluctuated with fuel oil pricing.

Containership operators devised fuel-saving methods and efficiencies, such as reducing ship speed, motifying existing vessels to be more fuel-efficient per ton of cargo carried, and specifying these charcteristics in new ships being built. Modern containerships are propelled by diesel instead of steam turbines, and contoured to operate more efficiently at speeds of 18-20 knots, instead of 30-33 knots as in the past.

Additionally, new ships coming out of construction yards carry many more containers than earlier ships, through more efficient use of shipboard space. With improved engines and more efficient stowage, containerships are cutting fuel cost per container by more than half.

Deregulation.

Deregulation also had a positive effect on land-sea intermodal growth. One of the first helpful moves was that TOFC and COFC traffic with prior or subsequent movement by vessel was completely freed from all ICC restraints, starting in 1979.

Changes in World Trading Patterns.

The business slowdown in ocean freight transportation between 1978 and the mid-1980s affected almost all routes, but differently. For example, the Far East gained strength while the North Atlantic faded considerably in volume handled, market share and in rate level. General world economy weakness, combined with growing worldwide over capacity of vessel and containers, caused extreme financial difficulty for many operators. This situation is expected to continue in the foreseeable future.

Logistics Management.

The concept of containerization has grown from the simple, traditional view of movement of containerized cargo between two points to today's view that encompasses understanding, managing and controlling the overall economics of the total move. This includes related costs and issues of inland and ocean movements, as well as manufacturers' inventory, production and demand costs.

11.17 A Capital-Intensive Business Made More Capital Intensive

Operating ocean-going vessels or other large transport vehicles, almost by definition, is a capital-intensive business. It is made even more capital intensive by increasing dockside labor costs and exclusive labor agreements, fueled by reoccurring worldwide economic inflation and competitive pressures. In a capital-intensive business, any change in volume or price quickly can turn fortune into disaster, or vice versa, as illustrated by modern maritime history.

Under competitive pressures, especially in a capital-intensive business, it sometimes is wise to carry freight at a price lower than fully allocated cost than to chance losing present revenue and market share. However, if such low-price freight becomes too large a proportion, and/or the practice continues too long, the carrier can suffer great financial difficulty. Three of the major influences of the early and mid-1980s- fuel price increases, deregulation, and changing trade patterns - combined to pose a cumulative challenge to containership operators.

Even though business conditions have improved since the mid-1980s, the fundamental risks for maritime fortune or disaster still exist because the business is so capital intensive.

11.18 Premium on Good Management

Increasing costs and competition have placed a greater premium on good management. Fuel price increases came so unexpectedly that a time lag occurred before equipment modifications and higher shipping rates could be realized. And when they were, most operators already were exposed to traffic losses. Deregulation " removed the safety net " to " let the marketplace rule, " even if it meant failure for less efficient operators. Changing trade patterns intensified competition for the remaining traffic.

Disruptions in the world marketplace, particularly the shift from Europe to the Far East, dried up once lucrative cargo volumes.

Against this backdrop, the capital-intensive maritime industry found that mistakes could easily be made by operating either too conservatively or too aggressively. Some carries lost out because they could not cope swiftly with change. Others, like Seatrain, which failed in 1981, were deeply into containerization. In times of stress, good management walks the narrow path between the extremes of rigid conservatism and excessive expansionism.

11.19 Future of containership operations

Well over 60 percent of the world's deep-sea general cargo today moves in containers. The percentage of containerized cargo is even higher between developed countries, approaching 100 percent in some cases. On these high-developed routes, it is increasingly difficult to raise containerization's share. Consequently, future gains will have to come from routes involving less-developed countries (LDCs). It will not be easily achieved on these routes because industries must be developed in the LDCs to promote two-way use of containers, and port facilities must be built to handle containers.

Currently, ro-ro and LASH vessels carry a large share of traffic on LDC routes because these vessels require less sophisticated port facilities.

11.20 Carriage of Bulk Commodities in Containers

Most general cargo is considered containerizable, whereas bulk cargo is not. However, some bulk commodities are beginning to be containerized. If this is a developing trend, especially for food commodities such as bananas, coffee and fresh fruits, it could open an entirely new avenue for increased container usage on all sea routes with new intermodal options.

11.21 Container Growth

World container traffic volumes increased by more than six times between 1970 and 1984, from 47.3 million metric tons (mt) to 318.2 million mt, an average rate of 16.2 percent annually. This period witnessed sharp swings in growth, such as the phenomenal average annual increase of 27.5 percent recorded between 1970 and 1974, followed by a relatively unstable period between 1974 and 1978 when the average annual increase was 15 percent. Renewed growth at a slower pace, especially after the adverse effect of the 1973-oil crisis, has been registered at 7.3 percent since 1978.

Recent studies indicate with an average growth rate of 4.5 percent, based on anticipated annual increases in world industrial production of just under 5 percent, containerized traffic should grow to 430 million mt in 1990 and 607 million mt by the year 2000. Actual numbers, of course, will reflect many unforeseen factors including general business, GNP growth and international politics. A forecast may include a boost from containerization of additional bulk and general cargo commodities, and increased containerization involving LDC routes.

CHAPTER 12

12.1 Government Regulation and Deregulation

The record suggests that government regulation of transportation limits and stultifies intermodality and that deregulation liberalizes and facilitates intremodality. Government regulation of any commercial enterprise tends to make it more rigid and less able to meet change with change. A rigid regulatory system simply does not provide the flexibility to allow for frequent change and development. (It is interesting to note that intermodalism developed at a far faster rate in Australia, Canada and Great Britain, where regulatory rates were often less restrictive than in many other countries including the United States).

Government regulation is not universally viewed as an impediment to transport development. Many are calling for re-regulation.

Some experts feel that certain practices, such as carrier liability, should be kept under government control in order to ensure intermodal uniformity and shipper protection. There are those who feel that the growing importance of intermodality calls for more, rather than less regulation in order to legislate uniformity and cooperation among otherwise antagonistic and competitive modes.

In spite of these dissenting views, an inspection of government regulation affecting intermodality indicates that, in many cases, government regulation was restrictive and therefore, inimical to intermodality.

12.2 Regulation in the United States

Regulation in the United States has been legislated and administered on a single modal basis with little regard for coordination among modes. Historically, regulation of each mode has been at separate points in time as each developed threatening economic characteristics noticed by legislators.

First to be regulated were railroads in the mid-and late - 1800s, then steamship lines in the early 1900s, followed by pipelines, motor carries and airlines in the mid-1930s. Legislation for each mode was patterned along lines of earlier models applicable to other modes, but were established as

separate statues applying to each mode, without consideration of intermodal coordination.

12.3 Separate Commissions

Separate commissions- the Interstate Commerce Commission (ICC), the Federal Maritime Commission (FMC), and the civil Aeronautics Board (CAB) - were setup under different acts to regulate a specific mode. Each commission was charged with promotion and welfare of their particular mode, which put even the commissions in competition against each other, rather than working toward an integrated intermodal system. There are some exceptions to this rule. For example, the ICC regulates inland waterways, trucklines, pipelines, and railroads, but is still has separate legislative authority and separate regulatory responsibility for each.

12.4 Competition for Grants

Modes also are pitted against one another rather than encouraged to cooperate on an intermodal basis. Each mode competes for government grants, for tax easements, for permission to raise weight or size limitations for loads carried, and for other subsides or grants of one kind or another. Regulatory commissions become involved on behalf of their respective modes in this competition. Public subsidies and other concessions can affect the relative cost competitiveness among modes, impact the region in which they are applied, and influence modal attitudes toward each other.

12.5 Ownership Restrictions

Legislation had prohibited carries of one mode from owning carries of another. For example, railroads could not own water carriers, freight forwarders could not own carries directly, and surface carriers could not own airlines. These prohibitions limited development opportunities for intermodality through common ownership.

12.7 Situation Prior to 1940

Prior to 1940, there was much legislative bias against intermodality. Antitrust laws were supposed to ensure free and open competition within and among modes to give the consumer an opportunity to get lowest price. Furthermore, the commissions had authority to suspend the effect of antitrust laws if they cooperative agreements among carriers to be in the public interest. One might think the commissions would encourage

intermodal agreements, but it did not work that way at all. Regulations promulgated by the commissions favoring through routes and rates and interchange points were, almost without exception, singlemodal-not intermodal. Each commission felt, with justification, that intermodal facilitation was beyond its scope. Each felt its powers were limited to regulating its assigned mode or modes. Government and industry working groups were established to facilitate intermodality, but these groups made relatively little progress because the underlying legislation was directed at single modes and did not give the commissions any significant intermodal authority.

12.8 Movement toward dergulation

The first small glimmer of light appeared in 1940 with a National Transportation Policy statement from Congress:

It is hereby to be the national transportation policy of the Congress to provide for fair and impartial regulation of all transportation subject to the provision of this Act, so administered as to recognize and preserve the inherent advantages of each; to promote safe, adequate, economical, and efficient service and foster sound economic conditions in transportation and among the several carriers; to encourage the establishment and maintenance of reasonable charges for transportation services, without unjust discriminations, undue preferences or advantages, or unfair or destructive competitive practices; to cooperate with the several states and the duly authorized officials thereof ; and to encourage fair wages and equitable working conditions; all to the end of developing, coordinating, and preserving a national transportation system by water, highway, and rail, as well as other means, adequate to meet the needs of the commerce of the United States, of the Postal Services, and of the national defense. All the provisions of this Act shall be administered and enforced with a view of carrying out the above declaration of policy.

The National Transportation Policy statement referred to" all modes of transportation, "indicating that they were being considered in relation to each other. However, the statement was limited to modes " subject to the provisions of this act, " which meant only modes regulated by the ICC.

It further recommended" developing, coordinating and preserving a national transportation system by water, highway, and rail, as well as by other means... "Which provided some further small encouragement to intermodality. Although there had been many speeches and other unofficial

comments previously about the need for an integrated national transportation system, this was the first official sign of recognition at the national legislative level that an intermodal relationship should exist. Curiously enough, air transportation was not specifically was not specifically mentioned at the time.

12.9 Department of Transportation Established

The next major step was creation of the U.S. Department of Transportation (DOT) in 1967 to encompass all modes. This was further recognition that singlemodal regulation and administration were inadequate. The same law that established the DOT in 1967 also provided that the Secretary of Transportation develop a new statement of National Transportation Policy. Implementation of any such policy, however required congressional action. DOT issued a number of policy pronouncements in the years that followed. In 1975 they were finally collected and edited into a new statement of National Transportation Policy.

12.10 National Transportation Policy Statement of 1975

The 1975 statement of National Transportation Policy went far beyond the policy statement of 1940. Congress never formally adopted the statement, but it served as the forerunner for deregulation legislation. The statement favored a healthy private-enterprise transportation system with minimum financial support by, and interference from, the federal government. It recommended less regulation of rates, freer entry, more employment of user charges, and more equitable administration of subsides. Above all, it favored elimination of unreasonable barriers to intermodal cooperation.

12.11 National Transportation Policy Statement of 1979

In 1976, the National Transportation Policy Study Commission (NTPSC) was authorized by Congress to formulate broad outlines and primary themes for improved transportation policy in the United States. The commission was composed of 19 members: 6 from the Senate, 6 from the House of Representatives, and 7 appointed by the President.

In its final report issued in 1979 and entitled National Transportation Policies Through the Year 2000, the NTPSC recommended multimodal systems planning rather than a single modal approach; reduced government economic regulation; equal government treatment among modes; more competition and improved efficiency by placing maximum reliance on

market factors; subjecting policy to economic analysis; more streamlined government organization; greater coordination of government efforts; and maximum use of the private sector. All these recommendations, if diligently pursued, would advance the cause and practice of intermodality.

12.12 No Single Intermodal Statute Exists

In the history of U.S. transportation legislation there has been no single unifying statute enforcing or promoting intermodality-and there is more now. Probably, in the long run, it can be argued that this is for the best. Intermodality thrives under free competitive conditions where carries have open options to negotiate interline rates and conditions with each other. Under these same conditions, shippers have flexibility to select among modes, carriers and combinations of carriers to obtain the rates, timing, and conditions best suited to their needs. A single unifying statute, favoring intermodality, might enforce some uniform conditions that would detract from the freedom and flexibility that permits innovation.

12.13 Impact of deregulation

Deregulation of transportation was implemented in the late 1970s and early 1980s though act of Congress and in steps taken by the regulator commissions to eliminate or liberalize rules and regulations that were considered unnecessary or unduly restrictive or burdensome. The deregulatory moves made intermodality more feasible, but transportation deregulation is not total. Nor has the deregulatory process been carried out uniform, or to the same extent in each of the modes. The net effect has been a big plus for intermodality, but a great many regulatory restraints remain depending on the mode combinations involved.

The following are some of the outstanding advances in intermodality that have been introduced through the deregulatory process in recent years. This is not meant to constitute a summary of deregulatory moves, but a listing of some of the major opportunities for intermodality through deregulation.

12.14 Rail-Truck deregulation

The mood in the regulation commissions in Congress favored deregulation in the late 1970s. Steps were taken in that direction by some commissions without waiting for statutory direction from the lawmakers on Capitol Hill.

In May 1979, the ICC deregulated rail rates on fresh fruit and vegetable shipments, resulting in a 26 percent increase in rail produce traffic the first

year. With their newfound freedom, railroads sometimes changed rates on produce traffic daily. The ICC also gave railroads freedom to establish special contracts with large shippers based on volume and service. Much produce and contract-rate traffic was diverted from through truck haul to an intermodal truck-rail-truck haul. Prior to deregulation rail shipments of produce, railroads carried 1 percent of this traffic; currently it is estimated that the rail market share is 4 percent.

The Motor Carrier Act of 1980 relaxed requirements for entry into the trucking business. The number of new trucking applicants in the first year of deregulation more than quadrupled, with the percentage of approved applicants rising from 69.8 to 94.5 percent. Many restrictions on truck route, types of traffic carried, and areas served were eliminated.

The Staggers Rail Act of 1980 made it easier for railroads to sell abandoned non-remunerative lines, and to eliminate or price competitively non-remunerative services. These was a substantial measure of rate freedom given to both trucking and rail modes. These changes provided shippers a wider range of price and service options and intermodal combinations of carriers.

12.15 Deregulation Liberalizes Joint Ownership

These acts helped to liberalize permission for carriers of one mode to own and operate carriers of another mode.In a decision under the new legislation, the ICC, effective January 6, 1983, eliminated most regulatory restrictions enacted in 1953 to protect the then infant trucking industry from the railroads. This new flexibility was greeted warmly by rail carriers but with some dismay by trucklines because rail carriers have a greater ability to acquire or develop new wholly-owned trucklines than trucklines of acquiring or developing railroads for joint operation. To the shipper, the decision means shipments can be made intermodally via a single carrier. Additionally, railroads now have more freedom to merge with each other, which provides greater flexibility, since single-line rates are not subject to rate bureau considerations and may be set or changed on a day to-day basis.

12.16 Rail Management Response

Formerly, in establishing motor carrier operations, railroads had to adhere to a special circumstance test that required them to prove there was overwhelming reason to grant them motor carrier operating authority. When granted, this authority was frequently subject to key point restrictions,

which in effect prevented railroads from offering anything other than radial patterns of service from key intermodal terminal "gateways." The combination of both these restrictions drastically limited the number of rail-controlled motor carriers, by placing an almost insurmountable burden of proof on railroads to demonstrate that the service was required. Even if granted, the key point restrictions severely constricted the economics of such operations. The only railroads that had sizeable motor carrier operations were those operations that were granted " grandfather " authority by the 1935 Motor Carrier Act.

In Ex Parte No. 156, issued in February 1984, the ICC eliminated the special circumstances doctrine for licensing new railroad motor carrier start-ups. New rail-affiliated trucking arms were merely required to meet the standards of fitness that applied to any other new motor carrier.

The special circumstances doctrine still applied to rail acquisition of existing trucking firms. However, in Ex Parte No. 438 it was ruled that three conditions must be met by a railroad purchasing an on-going trucking business: (1) that the proposed transaction is in the public interest, (2) that the motor carrier is integrated into the railway's operation and, (3) that there will be no adverse competitive effects on the motor carrier industry. This doctrine was ratified by the U.S. Circuit Court of Appeals for the District of Columbia, served June 23, 1987 in *Regular Common Carrier Conference vs. United States.*

Now that the railroads have wider authority to buy trucklines, their enthusiasm to do so varies widely from carrier. Some rail management's see it as competition against their own rail services, and others have been hurt by the poor performance of their trucking subsidiaries during the business recession that came on the heels of deregulation.

Others have taken advantage of technological advances and the more relaxed regulatory atmosphere to initiate successful new online truck-rail piggyback intermodal service.

A number of rail carriers have shown their eagerness to become totally integrated transportation providers. One of the first to become involved was the Norfolk Southern, which, in 1983, acquired North American Van Lines, one of the largest household goods movers and truckload freight carriers in the nation. Since its acquisition, North American Van Lines has played a very important part in introducing Road Railer service on the Norfolk-Southern by providing the highway portion of the movement. In 1987,

Union Pacific Corp. Purchased Overnite Transportation Company, the nation's fifth largest less-than-truckload motor carrier. Overnite provides consolidation for Union Pacific's double-stack service and provides joint truck-boxcar transloading service for the railroad. Union Pacific also has entered into a joint partnership with Skyway Freight Systems, an airfreight forwarder and trucking company to develop an information management system and electronic data interchange (EDI) communication network for multimodal applications. Burlington Northern attempted to purchase six truckload motor carries.

However, when the 1987 court decision was issued reaffirming the special circumstance test (*Regular Common Carrier Conference vs. United States*), Burlington Northern discontinued all its interest in these carriers.

Elsewhere in the world, railroads have been limited in their attempts to form integrated transportation systems. There have been several notable exceptions to this rule. One is the formation by British Rail of the Freightliner Corporation, which has operated a total intermodal service, including the highway movement, for over 20 years. In France, the French National Railways has formed a partnership with road handlers and railway wagon owners (freight car lessors) called Novatrans to provide door-to-door intermodal service. Canadian railways set the pace for U.S. railroads in terms of intermodal ownership. Because of the freedom both Canadian National and Canadian Pacific enjoyed relative to multimodal ownership, both raillines had trucking operations decades earlier than most U.S. railroads. Canadian Pacific not only owned several trucking companies (including Smith's Transport, one of Canada's largest trucking firms), but also owned an airline and a steamship subsidiary. Many transportation experts have noted this connection and the fact that Canada's domestic containerization was much further advanced than in the United States.

In many regards, ocean carriers have taken the lead from U.S. railroads in providing multimodal service. Not only have they started their own double-stack container trains, including ownership of the railcars themselves, but in some cases they own their own rail terminals and separate trucking subsidiaries. Currently, no organization is more advanced than American President Companies (American President Lines, American President Intermodal and Red Eagle Truck Lines), in providing a total intermodal service.

12.17 Piggyback Deregulated

An important deregulatory boost to intermodality was to free the rail portion of piggyback carriage from all ICC regulations. This was accomplished by legislation and an exemption promulgated in an ICC rulemaking procedure under the umbrella of the Staggers Rail Act. The ICC proceeding was entitled Ex Parte No. 230, and the results became effective March 23, 1981. Actually, the Ex Parte No. 230 proceeding was instituted on August 21, 1978, prior to passage of the legislation, but it was not pursued vigorously by the commission until late 1980, after both the Motor Carrier Act and the Staggers Rail Act became law. This action gave railroads greater ability to price piggyback competitively against truck hauls and increased flexibility for routing traffic on joint rail-piggyback hauls involving rail-owned trucklines.

The ICC instituted another rule making proceeding, Ex Parte No. 230 (Sub. 6), exempting truck rates from regulation in joint piggyback operations with railroads.

In Ex Parte No. 230 (Sub. 6), the commission extended its exemption to all motor carriers participating in a through intermodal movement by rail, regardless of affiliation or type of motor carrier. In its previous rulemaking (Sub. 5), the ICC had exempted railroad owned or controlled truckers. The only type of movement still regulated was Plan 1 service, traffic moved subject to a substituted service rule in the motor carrier tariff (see Chapter 5, *Intermodal Movements by Rail*). Later in 1987, Ex Parte No. 230 (Sub. 7) opened the record for deregulating even Plan 1 service. The October 29, 1987 clarification stated that the commission only intended to deregulate motor carrier intermodal service when it was provided in conjunction with a joint rate or agency relationship with a railroad. The status of pick-up and delivery service arranged by a shipper was still unclear at the time of this writing. It is hoped that this matter can be clarified even if by legislation. Many railroad managements support such a step and, of course, railroads would participate in the haul.

Deregulation of rail piggyback, combined with new intermodal technology and operating economies promises a change in long-haul shipping practices. Prior to rail piggyback deregulation, long-haul truckers were able to price their services below rail piggyback. Now, however, with the combination of rail ratemaking freedom and new types of equipment, the trend may move toward the direction of intermodality, with trucks providing mostly the initial and final portion of the haul.

12.18 Effect on freight forwarders

Recent changes in long-haul shipping trends will help freight forwarders. In the 1940s and 1950s domestic forwarders built a business by consolidating less-than-carload shipments into carload quantities, and then moving them on an intremodal truck-rail-truck routing. (Foreign freight forwarders, on the other hand, arranged transportation of cargo much like that of a travel agent for passengers.) Then came the trucklines, which were able to lure customers away from forwarders consolidating the shipments (as forwarders had done) and then moving traffic by truck all the way with low truckload rates.

Truckers were able to undercut freight forwarder rates, and the forwarders did not have the flexibility to retaliate. Most freight forwarders went out of business as a result, but a handful became truckers on the old theory that if you can't beat'em join'em.

Now that rail piggyback deregulation is reviving the popularity of the intermodal truck-rail-truck haul, forwarders are returning. Forwarders have two new competitive threats to worry about. First, with the newly-found door-to-door intermodal capability of railroads, they might supplant trucklines and forwarders in consolidating and moving freight. The second threat comes from the emergence of so many other types of intermodal middlemen (see Chapter 7), especially those who have invested heavily in EDI, who will compete vigorously against forwarders for the business.

12.19 Rail deregulation

Much concern was initially voiced regarding the effects of rail deregulation. Concerns included the cancellation of joint route and rate controls, liberalized merger provisions, elimination of reciprocal switching agreements, easier abandonment standards, and the threat of market abuse to rail captive shippers.

Fortunately, in the years since passage of the Staggers Act, many of these concerns have been laid to rest. Contrary to many dire predictions, rail rates have not skyrocketed. Both intermodal rail and truck competition have kept rail rates below the general inflation level. While some increases in specific rail rates have occurred, sufficient competition has kept most rates at reasonable levels. Rail intermodal services have expanded the scope of competition by extending service well beyond a rail carrier's own lines.

A few noteworthy mergers have taken place since passage of the Staggers Act, including Norfolk and Western /Southern, union Pacific / Missouri Pacific/ Western Pacific, Soo Line / Milwaukee

Road, Union Pacific / M-K-T (the Katy), and Southern Pacific / Santa Fe, which was disapproved and became Denver, Rio Grande and Western / Southern Pacific. To date, there have been no attempts at a transcontinental merger. Most industry observers believe that given the desirability of providing single line service and single line rates. a transcontinental merger is just a matter of time. With less than a dozen Class I railroads left, some observers are concerned about the future and the fate of " orphan " lines that remain unmerged.

Although rail mergers have not occurred at the frantic pace some predicted, there has been a notable increase in non-unionized regional carriers and shortlines since Staggers. The ease of abandonment under the act has just the opposite effect. Rail carriers are not compelled to provide labor protection. Rail carriers would just as well see an unprofitable railroad reorganize as a shortline rather than abandoned so that they can retain at least a portion of the traffic. New regional rails and shortline operators can turn a profit on lines that Class I carriers felt were not viable. This is because the regional and shortlines have a lower cost structure, a factor that has resulted in increased competition, especially where the shortlines are connected by two or more rail companies.

Some have been concerned about deregulation's impact on rail-dominated commodities such as coal. Coal shippers and coal-burning utilities have claimed that since the Staggers Act, railroads have exploited their monopoly position. They would like to see provisions for competitive access and reinstatement of reciprocal switching and compulsory joint rates. After maintaining a nearly neutral; policy, the largest shipper group, the National Industrial Traffic League came out in favor of legislation requiring competitive access.

Railroads, for their part, insist that coal rates have been inflated far less than utility rates for electricity. Furthermore, they argue no utility would be satisfied with the low rates of return suffered by the railroad industry (less than 5 percent in recent years), which is too low to continue to attract investment. The Federal Railroad Administrator, noted that there were shippers, but not nearly the number claimed. The administration believes mechanisms contained in the Staggers Act are sufficient to cope with the

problems. This issue is still being fought bitterly in Congress and probably will continue for some years.

Impacts of the Staggers Act on rail intermodal services have been generally positive. Feedback from America's large shippers generally has been quite favorable. Most negative comments regard service quality, not market abuse. Shippers would like to see intermodal rail service similar in quality to that provided by truckers. In nearly all instances, however, competitive pressures have kept intermodal rates falling rather than moving upward. Some observers question whether rates on rail dominated bulk commodities are being used to subsidize unprofitable intermodal service.

Many of the dire predictions made for regulatory reform in the motor carrier industry have failed to materialize. No area in the United States is without service. Nor have any reports of rate gouging surfaced. Major concerns have been the increasing concentration by the largest carriers in the LTL segment, and possible safety deteriorization in some marginally competitive operations. (For a more complete discussion, see Nicholas A.

Glaskowsky, Effects of Deregulation on Motor Carriers, Second Edition published by the Eno Foundation for Transportation, 1990.)

Opinion is divided on the effectiveness of motor carrier deregulation, perhaps it is even too early to judge its merits because not all the long-term economic effects have yet been felt. Nevertheless, it is sufficient to note that in a bibliograbhy of studies on deregulation complied by Dr. Edward Brunning in association with Sandra Loeb and Ann Kuzma, it was found that at the worst, motor carrier deregulation has had a neutral effect on users and a net favorable influence on carrier efficiency and competitiveness.

Looking ahead, it is difficult to envision any major changes in the current scheme of regulation, although several prominent shipper groups are pushing for total deregulation.

Nearly all benefits that total deregulation could confer have already been realized. If any changes are made, they will be budgetary, not philosophic.

The largest remaining problem is the discrepancy between regulatory requirements among various states, not only in regard to economic restrictions but also regarding size and weight limitations. The current situation varies so widely from state to state that it is a major headache for truckers. Lack of uniformity in regulations exists worldwide and is one of the main obstacles to overcome in achieving unification of the common market in Europe by 1992. An area of continuing regulation is safety. This

aspect, originally under the ICC's purview is now handled by the Bureau of Motor Carrier Safety. Safety has become such an overriding concern that in 1980 DOT created a new administration - the National Highway Traffic Safety Administration.

The emphasis on safety has important implications. With an aging trailer-on-flatcar fleet (the average age is currently over 8 years compared with 4.1 years for over-the-highway equipment), the ability of the intermodal industry to provide safe operations has been questioned. Maintenance practices of container chassis also has come under scrutiny. Furthermore, there are unanswered questions about violations of both federal and state weight limits and the effect on safety.

Another manifestation of the dichotomy between economic regulation and safety has been the practically simultaneous changes in regulation of the nation's commercial zones by the ICC and DOT. The ICC introduced rulemaking to extend the commercial zones of the nation's major cities, while Congress mandated DOT to establish a program to eliminate exemption of the commercial zone from safety enforcement.

Review of deregulation's effect on rail and truck traffic was conduct in 1983 by a major consulting firm on behalf of six railroads. The consultant's report noted that further increases in highway weight limits may be authorized, which would allow highway carriers to attract more bulk freight from railroads. The study also projected that trucklines might order larger trailers that might not fit railroad flatcars, and that these larger trailers could attract less dense freight. Another consideration was that the low inventory levels currently being maintained can be replenished more quickly by through-truck hauls. This is likely to be the major competitive battlefield.

12.20 Rail / Truck- Ocean (Domestic) Deregulation

In addition to freeing piggyback traffic from all regulations, the ICC also deregulated intermodal container movements between the U.S. mainland and Puerto Rico, Alaska, and Hawaii.

12.21 Rail /Truck- Ocean (International) Deregulation

Deregulation of all rail intermodal movement has helped promote long-haul rail-ocean traffic. It is still too early to determine whether the Shipping Act of 1984 has further promoted rail-ocean cooperation. There is, however, no doubt the 1984 Shipping Act has given a boost to single-bill intermodal rates by permitting ocean conference members to agree on inland rates

without violating provisions of antitrust laws. Nevertheless, many are convinced that trends in this direction were clear, even when carriers had to publish such rates on an individual basis. The service considerations and economics of double-stack movement made point -to-point price inevitable.

Railbridge services were first introduced in 1972 (see Chapter 5, sec. Titled *Bridge Services)*, including landbridge, minibridge and microbridge traffic.

These progressive rates permitted joint water and overland rail and truck services under a single bill of lading. In the early years there were many restrictions, including the requirement to file single and combination rates with the commission.

Deregulation legislation and rulemaking did away with the need to file intermodal rates and divisions of those rates with the ICC. The Shipping Act of 1984 permitted the Ocean Rate Conference to file joint rates covering both the inland portion and the water movement, of an intermodal movement, which could apply to many carriers on several routes. This freedom allowed carriers to establish through routes on and ad hoc basis, adjusting them daily if desired. Even more important from the standpoint of promoting intermodalism has been the ability of all participants to contract for rates and services, particularly rail and steamship operators. These rates and contracts if field by an oceanborne carrier must still be field with the FMC.

Rail and motor carriers do not have to file contract rates with the ICC. The amount of rail traffic actually moving under contract rates is between 40 to 60 percent, with the proportion increasing each year. This has increased the amount of competition between ports, as well as making it more difficult for competitors to obtain data.

Overall, however., it has increased shipper choices and has made intermodal shipment a more viable option.

12.22 Maritime legislation affecting intermodality

U.S. maritime law, insofar as it affects intermodality, consists primarily of the following acts ; Shipping Act of 1916, Merchant Marine Act of 1920, Intercoastal Shipping Act of 1933, Merchant Marine Act of 1936, and the Shipping Act of 1984.

The 1916 act provided antitrust immunity, permitted carriers to form open conferences, and created a U.S. Shipping Board to regulate and promote ocean commerce. The name of the U.S. Shipping Board was changed

several times, finally becoming the Federal Maritime Commission (FMC), which in 1961, was established as an independent regulatory agency. Promotional activities on behalf of the U.S. Merchant Marine were assigned in 1961 to the newly-separated (from the FMC) Maritime Administration (MarAd), reporting to the Secretary of Commerce. In 1981, MarAd was transferred to the jurisdiction of the Department Transportation.

12.23 Federal Maritime Commission

The major intermodal functions of the FMC are:

(1) Regulating ocean carrier ratemaking on foreign and domestic routes ;

(2) Investigating discriminatory rates and practices among shippers, carriers, terminal operators, and freight forwarders;

(3) Licensing ocean freight forwards; and

(4) Ensuring that carriers serve the public interest.

The FMC regulates liner trade to and from the United States, and provides antitrust immunity to shipping conferences to the extent it finds conference activities to be in the public interest. In this connection it requires all liner tariffs to be field. It prohibits rebating, pooling, or " rationalization " of services, unless approved by the commission. Up until passage and signing of the Shipping Act of 1984 (see Appendix A), it prohibited conferences from establishing through intermodal rates to and from inland U.S. points.

Table 1 - Breakdown of Container Slots in Service and Those on Order by Nationality of Beneficial Owner (November 1, 1987)

1986 Position	Country of Ownership	TEU Slots	1985-86 % Change	1985 Position	New Building TEU Slots	As % of Existing Fleet
1	West Germany	327,013	- 3.5	1	21,848	6.7
2	USA	247,058	0.1	2	20,900	8.5
3	Japan	229,528	16.4	3	20,228	8.8
4	Taiwan	175,918	15.9	5	20,862	11.9
5	UK	152,244	- 1.3	4		
6	Hong Kong	125,422	10.2	6		
7	Norway	103,192	2.2	7	3,360	3.3
8	Denmark	96,867	1.2	8	20,010	20.7
9	USSR	94,489	14.6	11	5,206	5.5
10	Netherlands	87,918	13.2	12	3,330	3.8
11	France	85,224	- 4.8	9		

12	Greece	84,777	21.5	13		
13	South Korea	83,547	0.5	10	18,701	22.3
14	PRC	74,582	15.4	14	8,328	11.1
15	Singapore	50,243	7.0	16		
16	Italy	47,763	-1.8	15	14,264	29.8
17	Yugoslavia	41,652	24.4	18	2,800	6.7
18	Sweden	40,091	- 3.0	17		
19	Belgium	32,305	1.2	19		
20	Israel	28,858	-3.5	20		
	Mexico				8,276	100.0
	Poland				7,047	30.1
	UAE				3,880	52.5
	East Germany				3,492	15.4
	Brazil				2,479	9.0
	Cuba				2,172	22.7
	Bangladesh				1,500	65.9

Source : Containerization International Yearbook, 1988.

12.24 Maritime Administration

The major mission of MarAd is to develop and maintain an U.S. - flag Merchant Marine. It administers federal ship construction and operating subsidies to permit the U.S. Merchant Marine to compete against lower-cost foreign operators. It also promotes and supports concepts and projects that advance technological improvements abroad vessels and in ports.

In regard to the maritime industry, lawmakers focus much attention on the well being and promotion of the U.S. Merchant Marine. Concern has been expressed over the apparent decline in U.S. - flag shipping. Ninety percent of the world's trade moves by sea in some 25,000 ships. As of 1979, the U.S. - flag merchant fleet ranked eleventh in the world 9 361 active ocean-going vessels), having declined year after year from its first-ranked position in 1945. Panama ranked fist with 3,278 ships. In the mid- 1980s, U.S. - flag vessels accounted for less than 5 percent of the international ocean trade. These overall figures do not necessarily give an accurate indication of moves within the industry.

For example, the percent of U.S. breakbulk and container trade carried in U.S.-flag vessels was less than 35 percent while the U.S.-flag share of dry bulk and tanker traffic was just a little more than 2 percent. U.S.-flag registry, furthermore, does not necessarily coincide with U.S. ownership (see Table1). It is to the shipowners' advantage to register their ships in

foreign countries and operate them according to foreign rules and with foreign crews. In recent years, U.S. ownership of foreign-registered vessels almost equalled the number of U.S. registered vessels, and tonnage of American-owned foreign-flag vessels (see Table 2).

Merchant fleets of many other industrial nations also have declined. The higher cost of labor for constructing and operation ships in developed industrial countries (compared to less-develop countries) has caused much of this situation. The last merchant ship built in a U.S. yard was launched in 1987. Since 1980, 76 shipyards have closed. No ocean ships are currently being built in the United States, and none are on order.

Table 2 -U.S. -Flag vs. American-Owned foreign-Flag Vessels (1977 / 1986)

	U.S.-Flag				American-Owned Foreign-Flag			
Type	1977 No.	1986 No.	1977 Tons	1986 Tons	1977 No.	1986 No.	1977 Tons	1986 Tons
General Cargo*	291	205	4,373	4,449	43	53	225	612
Dry Bulk**	18	26	529	1,270	94	52***	5,338	2,854***
Liquid Bulk***	262	225	11,964	14,812	349	256	46,849	31,287
Total	571	456	16,8661	20,531	486	361	52,412	34,753

* Measured in gross tons ; includes both freight and combination freight / passengership

** Measured in deadweight tons

*** Statistically broken out to include both bulk and oil carriers.

Source : U.S. Flag Statistics from Maritime Administration " Merchant Fleet of the World," January 1, 1987.

12.25 Maritime Relatively Unaffected by Deregulation

Maritime regulation has been relatively untouched by the wave of deregulatory sentiment that has so changed laws and procedures for other modes. The minor changes that have occurred consist mostly of reactions to changes made in other modes. The reason for the relative lack of change in maritime regulation is that many powerful forces with opposing views have stalemated each other.

Balanced against those who would strengthen the conference system, there are many shippers who have profited from competition by non-conference operators, and by trans-border intermodal movements via Canada. Opposed to those who want grater government subsidy support for U.S. shipbuilding despite continued White House policy to cut subsidies, are shipowners who want to build cheaper vessels abroad.

As a result of these and many other differing viewpoints, maritime legislation, introduced into both the House and Senate in 1979 failed to pass. A new bill was submitted in each House of Congress in 1981, each entitled " The Shipping Act of 1981," but these titles had to be changed to " The Shipping Act of 1982 " because of slow progress. Although the House bill passed overwhelmingly, the Senate bill was bottled up, and so the 97th Congress adjourned without producing any new maritime legislation. The " Ocean Shipping Act of 1983 " was introduced early in the Senate side of the 98th Congress with hearings commencing February 2, 1983.

12.26 Shipping Act of 1984

The most important intermodal aspect of the proposed 1983 legislation was that it would permit intermodal through rates to be established. In other respects it supported the conference system generally with a continuation of antitrust immunity and requiring conference rates to be filed with the commission. However, opposing forces balanced each to such an extend that the legislation was held over to another calendar year. It was finally signed into law on March 20, 1984 as " The Shipping Act of 1984. "

The Shipping Act of 1984 is comprehensive and detailed (see Appendix A), containing clauses of interest to intermodality. It calls for FMC to implement or review provisions applicable to the role of middlemen (such as NVOCCS and ocean freight forwards) in promoting intermodal carriage.

The 1984 act rewrote, revised and encompassed previously passed laws and regulations that were generally agreed to be outdated. The new law established the basis for streamlining FMC procedures, especially in the area of rate regulation and agreement processing. Antitrust immunity for carriers, conferences and ports was redefined to allow for greater rationalization of resources and services.

It permitted shippers and carriers to negotiate service contracts or volume pricing outside the tariff system. (A service contract guarantees a certain price for a particular commitment of cargo from the shipper for a fixed portion of its cargo to a carrier.) Conference carriers received the mandatory

right to withdraw from a conference rate. It gave smaller shippers the right to form shippers' associations to increase their influence on carriers similar to what larger shippers were able to do previously. (Shippers' associations, nonprofit groups of shippers, who consolidate members' freight to secure volume rates or service con tracts, existed for many years in Europe and Canada in maritime trades that did not involve U.S. cargoes or ports). The 1984 act also set up a 5-year review process, with specific instructions to study the continued need for port and maritime terminal antitrust immunity and whether tariffs should be filed with and enforced by the commission.

12.27 Deregulation of land-waterway transport

The theory of deregulation is that " the market-place should prevail " without undue influence of restrictive government regulation. The corollary is that user charges should be assessed on carriers and ports to permit government to recover its costs of maintaining facilities. This is another way of letting the marketplace prevail - by allocating to each mode the actual public cost that makes operation possible. Payment of user fees would raise the costs of inland waterway carriers more than those of carriers in other modes. A key provision of the Water Resources Development Act of 1986 includes graduated costsharing arrangements between local agencies and interest groups for new construction of channels. Ocean ports also are being required to repay government for maintenance of harbors and facilities.

12.28 Competitive Relationships among Modes

The federal government is pushing for cost recovery and, to the extent that it is successful, it may change the competitive position of each mode involved.

The inland waterway operators faced imposition of a fuel tax for the first time in 1980, but there still are not any lockage fees, except on the St. Lawrence Seaway. Since that time there have been no noticeable increases in rail tonnage. The trucking industry also was faced with a $0.05 per gallon fuel tax increase contained in the Surface Transportation Assistance Act of 1982. Increased nationwide size and weight limits offset additional expenses in fuel taxes to some extent. On balance, increased size and weight limits have made the long-distance trucking industry more competitive with the nation's railroads. There remains a question of equity in relation to how

adequately user fees cover capital and operating subsidies by government. This debate is being conduct worldwide and has as much relevance in Germany as it does in the United States. The battleground of further increases in both vehicle dimensions and weight allowed on highways will determine very clearly whether intermodal service can remain competitive in the future.

12.29 Effect of Rail Deregulation on Rail BargeIntermodality

Transportation by inland waterway traditionally has been a low-cost option for shippers of bulk commodities. Fierce competitive battles have occurred over the years between water carriers and railroads for traffic. Bargelines have accused railroads of monopolistic practices by setting rates high at barge connecting points in order to divert traffic to an all-rail haul.

The Staggers Act gave railroads the ability to cancel joint rates and through routes, coupled with greater freedom to merge. Bargelines fear this gives railroads every incentive to close off intermodal rail-barge interchange. This fear was brought to a head in 1984 when CSX Corp., a major rail holding company, acquired American Commercial Barge Lines, one of the nation's largest waterway operators. The Coal Exporter Association expressed the greatest alarm.

To date much of this concern seems unnecessary. Barge-rail interchange and joint rates are increasing, not decreasing. No other rail carrier has acquired a bargeline since the commission gave its historic blessing.

Perhaps even more significant, with nearly a decade of experience under the Staggers Act, no barge carrier has field a complaint under Section 707 of the act, which prohibits any practice that is " unfair, destructive, predatory, or otherwise undermines competition. " It appears deregulation encourages cooperation, yet does not destroy competition.

12.30 Air cargo deregulation

Airfreight was the first mode to be deregulated by formal legislation in the wake of the National Transportation Policy Statement of 1975. Amendments to the Federal Aviation Act implementing deregulation of airfreight were made effective in the Air Cargo Act of 1977. Deregulation of air passenger transportation came later (Airline Deregulation Act of 1978), and of rails and trucks still later (Staggers Rail Act of 1980 and Motor

Carrier Act of 1980). In addition to being first, airfreight was foremost, in that it was deregulated almost entirely in terms of entry or withdrawal by carriers and freedom of ratemaking.

Air deregulation was a precursor to deregulation in other modes also in that the regulatory commission-in the case of air, the CAB - made more or less spontaneous moves toward deregulation prior to, and concurrent with, formulation and passage of legislation by Congress. The trend toward air deregulation was bipartisan, starting in the Ford administration in late 1974.

The Senate Subcommittee on Administrative Practice and Procedure, Committee on the Judiciary, held hearings directed toward regulatory reform in late 1974 and early 1975. The subcommittee issued a report in February 1975 critical of CAB's restrictive regulatory practices. Particularly criticized was a route moratorium under which entry had been precluded to new applicants, and rigid pricing policies had been maintained. In January 1975, the CAB chairman, possibly anticipating Senate action, set up a special staff on regulatory reform to study the impact of CAB regulations on the economics of air transportation. The special staff issued its report in July 975 with recommendations that the CAB proceed immediately with an experimental relaxation of regulation in the cargo area, and gradually revise its policies to introduce price, and entry competition in air transpiration.

An interesting regulatory difference between air and other modes is that the Federal Aviation Act deals mostly with passengers carriage, whereas freight has been the dominant objective of most surface transportation regulation since its beginning.

Most air deregulation has been in passenger carriage, probably because it is of more popular interest and attracts more public attention. (For a complete discussion on air passenger deregulation, see Melvin A. Brenner, James O. Leet and Elihu Schott, *Airline Deregulation,* published by the Eno Foundation, 1985).

12.31 Implementation of Airfreight Deregulation

Airfreight deregulation, effective November 1977, was implemented in two steps, one immediately applicable to so-called " grandfather " carriers already engaged in airfreighter operation, and the second a year later, opening the field to all applicants and completely liberalizing airfreight ratemaking.

12.32 Airfreight Forwarder Deregulation

CAB granted airfreight forwarders freedom of ratemaking and ease of entry for new applicants. The umber of airfreight forwarders grew from 300 in 1976 to over 1,200 in 1979. By the late 1980s, their numbers decreased to about 700 because of mergers, consolidations and bankruptcies. Airfreight forwarders have always had a freer hand than their surface counterparts, filling pretty much the combined roles of forwarder, agent and non-vessel operating common carrier by water in surface transportation.

All airfreight is intermodal in the sense that freight moves to and from airports by surface transport means. Single-document intermodal air waybills have been common for many years. In terms of intermodality, the effect of deregu!ation on airfreight has been the same as in other modes - to dive shippers a wider choice of modes, carriers, combinations of modes and carriers, and of combination and joint rates from which to choose.

12.33 Rapid Expansion by Air units

Air carriers, airfreight forwarders, courier services, small commuter airlines and nonscheduled airlines have taken advantage of deregulation by expanding into each others' areas. For example, some larger airfreight forwarders have purchased or leased planes and have in effect become airlines to a large portion of their business. This occurred at the same time the number of air forwarders was expanding explosively. Today, there is a small number of large forwarders operating their own aircraft. In response to airline-type activities of airfreight forwarders, many scheduled airlines have taken on consolidation and door-to-door transport activities formerly considered the preserve of airfreight forwarders.

12.34 Rise of Express Delivery Operators

One of the most spectacular phenomena emanating from airfreight deregulation has been the rise of express package delivery operations. By making it easier to acquire larger, more efficient aircraft, deregulation has helped express delivery operators such as Federal Express and DHL develop more rapidly.

12.35 Blurring of Distinctions

The result of all of this has been termed a blurring of distinctions among various types of operators in the airfreight field. Previously, classes of carriers could be considered separately, and carriage statistics analyzed by

scheduled carriers, forwarders, and express-package operators, This no longer is possible because almost all entities are engaged in multiple aspects of the business and the statistics are commingled.

12.36 Impact of the Motor carrier Act on Air

The Motor Carrier Act of 1980 exempted from regulation "... transportation of property (including baggage) by motor vehicle as part of a continuous movement, which prior or subsequent to such part of the continuous movement, has been or will be transported by an air carrier..." This gave free rein to greater possibilities of intermodal air-truck transportation. The CAB previously specified a 35-mile radius limit around airports for surface transport pickup and delivery services in connection with air transport, and had required carriers to file separate tariffs describing their pickup and delivery services beyond the 35-mile zone.

These restrictions were eliminated by CAB in regulations issue under the new law.

Since 1941, U.S. airlines have jointly owned Air Cargo, Inc. (ACI), which provides pickup and delivery services at U.S. cities. ACI has provided service with its own truck and indirectly through contracts negotiated with local trucking firms. CAB granted ACI immunity from antitrust laws until December 1981 when it withdrew the immunity.

Since the ACI agreement did not obligate airlines to use ACI trucking contractors exclusively, the effect of withdrawal of antitrust immunity was slight. But, in consonance with other deregulatory moves, it encouraged a greater of choice in intremodal transportation.

CAPTER 13

13.37 Intergovernment Regulations of U.S.

13.37.1 INTERNATIONAL INTERMODAL AIR TRADE

International transportation regulation involves two governments, or in the case of multinational regulation, several governments. Therefore, intergovernment regulation requires more time to negotiate and to ratify than does domestic transportation regulation.

In many cases, other governments, representing both developed and less developed nations, were not ready to move along the deregulatory path. In fact, many countries resented and objected to the United States' deregulatory bent, interpreting it as an effort to give multiple U.S-flag air carriers advantage over airlines operating under the flags of other countries.

This led to a series of confrontations and negotiations between the United States and other nations where air deregulation was advanced somewhat, but not to the extent as in the United States. Entry rules for new carriers were eased and ratemaking was relaxed, but both remained restricted to varying degrees, depending on countries involved. The conference system of the International Air Transport Association (IATA) continues to be approved and given antitrust immunity.

The following deregulatory moves were made by the United States on a fairly unilateral basis:

1. Requirements for air cargo rate filings were eliminated.
2. Enforcement of IATA cargo rate agreements was dropped.
3. Cargo agency commissions were freed from regulation.
4. Airfreight forwarders were released from regulation.
5. Transportation of property in the United States by motor vehicle, as part of a continuous domestic or international air movement, was exempted from provisions of the Motor Carrier Act of 1980. This meant it was free of motor carrier regulation. However, an important exception was included: if the air movement is by a foreign carrier the exemption has to be "... so agreed by the United States and approved by the Civil

Aeronautics Board or its successor agency... " This exception ensures reciprocal rights for U.S. air carriers in foreign countries. Additionally, the 35-mile radius was retained as a limit on intermodal air-surface operations of foreign air carriers in instances where their governments would not give reciprocal intermodal rights to U.S. air carriers. (For further detail on how this exception works in respect to intermodal competition between U.S. and foreign-flag airlines, see Chapter 11, sec. titled Competition Between U.S. and Foreign Air Carriers.)

Since a foreign airline must have prior approval of its route authority in order o operate scheduled services to and from the United States, the exemptions from the Motor Carrier Act and the approval to provide air-motor intermodal service is based on such route authority.

13.37.2 UNCTAD LINER CODE

For many centuries the freedom of the seas was an accepted concept : ships of any nation could trade among ports regardless of whose flag the vessel flew. The only restriction was that ships of one nation usually were prohibited from carrying on domestic trade in another nation. Today, under the UNCTAD Liner Code of Conduct, there is a new way of allocating ocean trade by flag carrier. The code was developed and refined in meetings held under the auspices of the United Nations Conferences for Trade and Development (UNCTAD) and into effect in 1983. The code proposes that liner trade between any two nations be allocated equally to the flag carriers of those two nations, with smaller parts of the trade set aside for vessels of third countries or " cross trades ". The standard allocation is 40-40-20, with 40 percent for flag vessels of the two primary countries and 20 percent for cross traders.The formula was intended to help less developed countries (LDCs) establish their own maritime liner services. Liner services include containership operations, and full maintenance of the code could impact intermodal trade.

13.37.3 EFFECT OF LINER CODE ON INTERMODALITY

The introduction of LDC liner services would appear to expand intermodality, but there are many factors involved that could accomplish the opposite end. Whenever free competition is restricted and entry of carriers is circumscribed, rates tend to rise and carriage conditions become less favorable. An allocation of capacity is like any system of market allocation or trade restrictions, and usually operators are not enthusiastic about instituting improved systems (including intermodal options) for the

consumer's benefit. The underlying question is whether having a national-flag liner actually helps the economies of LDCs or whether it is an expensive and economically draining prestige effort that raises consumer prices. The flag flown by the vessel does not always represent the nationality of the owner. Certain LDCs have made a business of providing flags-of-convenience for owners. These LDCs offer convenience in the areas of taxes and relaxed safety requirements, and provide crews to man vessels. Liberia and Panama are known for flags-of-convenience registrations.

13.37.4 PROTECTIONIST MOVEMENT

In UNCTAD meetings, the LDCs indicated a desire to push discriminatory further by requiring that local labor perform all functions at the port and that liability insurance be underwritten in that country rather than tendered for competitive bid worldwide.

Despite the fact that U.S. deregulation has established a more competitive atmosphere, encouraging intermodal experimentation in both domestic and international trade, the UNCTAD protectionist movement is afoot, imposing new restraints in the international maritime field.

The UNCTAD Liner Code became effective after

(1) ratification by 24 nations and

(2) endorsement by nations with 25 percent of the world's liner tonnage as of 1973.

Even through the UNCTAD code is in effect between many other countries, the United States still refuses to recognize it. To counter this action, the United States is proceeding with bilateral negotiations with its trading partners.

Although these agreements represent another allocation system stultifying competitive initiative, it is a America's only retaliatory alternative.

The European Common Market countries opposed the UNCTAD Code, but in Spring 1979 found a modus vivendi in an exception known as the Brussels Package, in which reciprocity, rather than cargo, is the rule among EEC and like-minded OECD countries.

13.37.5 THROUGH INTERMODAL LIABILITY PROVISIONS

Through origin-to-destination liability provisions are important to intermodality. It is desirable that uniform conditions and limitations be applicable to each mode in a through movement. An equally important requirement is that documents of carriage spell out conditions and limitations applicable to each mode and carrier.

Since federal government regulation was directed at each mode separately, significant differences exist with regard to liability in regulatory requirements among modes.

Inter-agency task forces have worked on establishing uniform provisions and limitations of liability for a through intermodal movement, but without much success. As a practical matter, the liability provisions of each mode apply, especially where rates are a combination of the local rates of carriers involved. Where a through joint rate has been established, the higher provisions and limitations of the modal carriers usually apply.

13.37.6 LIABILITY PROVISIONS CHANGED UNDER DEREGULATION

Deregulation eased government control over liability provisions and limitations and as a result, caused some protest and debate. Some liability and claims specialists contend that carriers have taken unfair advantage of deregulation by lowering their liability limits and otherwise evading their responsibilities to shippers in cases of loss or damage to cargo. They feel that most shippers are not aware of their new vulnerability until they meet with a problem-and then it is too late. They advocate that liability standards be separated from other measures, and that legislation be adopted prescribing uniform liability limits, claim-filing time limits and other reasonable standards for all modes of freight transportation.

The Shippers National Freight Claim Council is one of the strongest voices advocating uniform liability provisions. This seems antithetical to the general thrust of deregulation, which is intended to give freedom in the relationship between shippers and carriers. There is no doubt that this has been one of the thorny issues in deregulation because of changes in rules and the welter of conflicting tariff rules. It also has been one of the most troublesome aspects of piggyback deregulation.

13.37.7 LIABILITY VS. CARRIAGE RATES

Opponents of a re-regulatory approach maintain that there is a tradeoff between liability rules and rates for carriage-that carriers would not be as free to lower rates for carriage or provide better conditions of service if they were burdened with the cost of strict government-imposed liability rules. They feel it is much more cost-effective for the shipper to take out his own insurance tailored to the specific needs of his cargo.

13.37.8 OCEAN CARRIER LIABILITY PROVISIONS

The Shippers National Freight Claim Council has taken a more cautions stand regarding government regulation of international ocean-carrier liability rules. In 1982, its task force on international liability rules almost unanimously favored the " Hamburg Rules ", which would enforce ocean common-carrier coverage and conditions. But, the council itself, a day later, decided to postpone adoption of a formal position until more facts were known. The council was persuaded by Douglas A.

Jacobsen of the American Institute of Underwrite, who maintained that if the Hamburg Rules were adopted, freight rates were likely to increase by a greater amount than cargo insurance rates would be reduced.

The Hamburg Rules on ocean carrier liability were draw up in 1978 under the auspices of the United Nations. They provide uniform common-carrier liability for ocean carriers starting from acceptance of goods by the ocean carrier to delivery at destination port. They place the burden of prcof on the carrier. The Hamburg Rules have not gone effect because they have been ratified by only 12 countries of the minimum 20 required.The United States and the European Shippers Council, representing 15 countries among others, have not ratified them, although some positive signs have developed lately.

13.37.9 UNIFORM INTERNATIONAL INTERMODAL LIABILITY RULES

The concept of uniform international liability rules for intermodal transport (with emphasis on land-sea) surfaced in the early 1960s with expansion of the container revolution to many parts of the world. The first draft was started in 1965 under auspices of the International Institute for unification of Private law and the Comite Maritime International. In 1967, a draft convention was produced at the " Tokyo Round". In 1971, another draft was discussed at a meeting in London sponsored by the Intergovernmental

Maritime Consultative Organization and the Economic Commission for Europe.

In 1973, the Economic and Social Counsel of the United Nations requested that the Trade and Development Board of UNCTAD establish an intergovernmental preparatory group on international intermodal transport to prepare a preliminary draft convention " bearing in mind, particularly, the needs and requirements of developing countries."

UNCTAD veered from the London draft, which had been prepared largely by delegates from developed countries, and held six preparatory sessions and a two-part diplomatic conference, from which the United Nations Convention on International Multimodal transport was finally adopted in May 1980.

Adoption does not mean that the convention is in effect. The convention requires ratification of at least 30 countries, and will not apply to and from a country that has not ratified it. There is such considerable opposition to it, that it is doubtful it will be ratified by the United States.

The basis for liability set forth in the convention is presumption of fault on the part of the multitransport operator (MTO), and the burden of proof or lack of fault is on the MTO. Standard limits of liability are specified for each mode, and the MTO is liable for the goods from the time it accepts them until it makes delivery.

13.37.10 APPROACHES TO MULTIMODAL LIABILITY PROVISIONS

There are two approaches - regulatory and deregulatory-regarding loss or damage to intermodal cargo. The regulatory approach (taken by a single government for domestic application or by several governments for international application) imposes a uniform system to replace what otherwise may be a confusing patchwork of differing modal liability limits and procedures.

The deregulatory approach lets competition seek the lowest rate level for the consumer's benefit. The two approaches are still being debated and only time will tell which system will prevail.

13.37.11 INTERNATIONAL AIR CARRIER LIABILITY

The Warsaw Convention, a treaty governing liability procedures and limits for air transportation, was adopted in 1929 and ratified by the United States in 1934. In 1983, the U.S. Senate questioned the validity of the Warsaw Convention by voting against two facilitating amendments known as Montreal Protocols 3 and 4. The convention is still effective, albeit weakened.

The Warsaw Convention applies to international air-surface intermodal transportation where covered by a single air waybill and subject to a through rate.

However, airline deregulation encourages creativity in the establishment of through rates for carriage and liability, thus the conflict in philosophies carries into international air-surface intermodality as well.

The Staggers Rail Act and the Motor Carrier Act are applicable to U.S. interstate and foreign commerce. Where the domestic surface of the haul has been deregulated (as in the case of rail intermodal), domestic and international air carriers are free to introduce separate liability provisions for the portion of the haul.

CHAPTER 14

14.1. INTERGOVERNMENT REGULATION OF INTERMODAL CONTAINER SAFETY

Intergovernment regulation of intermodality encompasses uniformity and safety of shipping containers used in international transportation.

The International Maritime Organization - an intergovernmental group - sponsored the international Convention for Safe Containers (CSC) which has been accepted by most countries, including the United States. The CSC specifies construction details for containers, periodic inspections and testings, and a uniform marking system for containers to show test strengths and other safety indicators.

Since there have been difficulties in getting all containers marked with the standardized " data plate", indicating the containers' safety condition, the CSC effective date was postponed from September 1982 to January 1985, making it easier for additional countries to join.

Some container marking provisions of the CSC overlaps those of the International Standards Organization. However, steps are being taken in both organizations to rationalize the marking systems.

Essentially, the CSC is a maritime activity. However, anything dealing with standardization of conditions relating to intermodal containers has an effect on intermodal activity. Air containers currently are exempt from CSC regulations, and the exact dividing line between air and sea containers has yet to be fully defined. To be completely intermodal, air-sea-containers would have to meet CSC standards.

14.2 Greater Scope for Intermodality

Increased intermodal activity is promised if regulations are relax and if government agencies are combined or their scope reduced. Shirley Ybarra, Special Assistant for Policy, U.S. Department of Transportation, indicated the direction of federal policy at the 1984 conference of the Containerization and Intermodal Institute.

Deregulation is clearly the wave of the future ; burdensome regulation is a relic of the past. Consumers are experiencing a new era in transportation - an area of lower costs and greater choices. The big winner under deregulation is the traveling and shipping public. The Administration believes in free enterprise.

We're doing all we can to restore it, and will vigorously resist any and all attempts to undo the deregulation legislation of the last decade... The outlook for improved efficiency in transportation goes hand in hand with intermodal transportation. The future for intermodal transportation has never looked brighter.

This is the intermodal age. The United Stated and other governments are taking steps to try to adjust their regulations to cope with it. In some cases they are trying to unify regulations so that they can apply to the through movement of freight via several modes. In other cases, they are working toward elimination of restrictions, so as to allow room for commercial ingenuity. Relaxation of government controls, combined with technological improvements, such as computerized rating, fuel-efficient vehicles, and higher truck weight limits, promise even greater scope for intermodality in the years ahead.

CHAPTER 15

15.1 Types of Intermodal Movements

Cargo can be divided into four classes; general, bulk, neo-bulk and outsize. Cargo movements are classified as online versus interline, and singlemodal versus intermodal or multimodal. Cargo conditions may be classified as loose, sometimes known as breakbulk, or containerized. Cargo volume for rating purposes can be classified as carload/ containerload (CL) or truckload/ trailerload (TL) versus less-than-carload/ containerload (LCL) or less-than-truckload/ trailerload (LTL).

15.2 Cargo classes

General cargo consists mostly of semi-manufactured, manufactured and packaged commodities. General cargo is the kind most often containerized, and also is defined as " anything other than bulk." Bulk cargo consists of basic commodities such as grain, petroleum products, coal, sulfur, and other materials that are voluminous and loose. They are usually (but not exclusively) transported in large volume by bulk carriers such as barges, tankers, pipelines, or unit trains. Neo-bulk commodities are usually handled like bulk commodities, either by grab bucket, or in a unitized load, but usually do not move in huge quantities requiring specialized equipment. Neo-bulk cargos generally include a limited a number of commodities such as scrap iron, steel, lumber, automobiles and paper.

Outsize cargo is general cargo that is so heavy or large it cannot be accommodated in standard containers or handled by normal means, and requires use of special loading and/ or transport equipment.

15.3 Cargo Movements

An online movement is one undertaken by a single carrier. In an interline movement, cargo is transferred between two or more carriers. A single modal movement involves one or more carriers of a single mode. An intermodal movement involves transfer of cargo from one mode to another. A multimodal movement involves transfer of cargo more than once, involving two or more modes. Intermodal can also describe a multimodal movement.

An online movement signifies a singlemodal movement, while an intermodal movement usually involves transfer between carriers of different corporate entities. With the accelerating development of multimodal transportation companies under deregulation, these labels are no longer as indicative as they once were.

15.4 Cargo Condition

Cargo may be in loose condition (not in containers) or it may be containerized. Containerized condition implies use of intermodal or singlemodal containers or unit load devices.

In ocean shipping the term " breakbulk " is generally equivalent to " loose " in other modes. It denotes general cargo that is loaded into a breakbulk vessel. It may be loose, palletized or bagged, or otherwise unitized, but not containerized for containership carriage.

15.5 Cargo Volumes

In the maritime trades, containerload (CL) is contrasted to less-than-containerload (LCL), and in highway service, trailerload (TL) is contrasted to less-than-trailerload (LTL). In the rail mode only carload (CL) service, multiple car shipments and unit trains are appropriate shipment sizes. LCL movements have ceased to exist, both for ratemaking purposes and in point of fact.

These distinctions have traditionally signified differences in shipment size, as well as rates applied The CL or TL rate per unit of weight or measure usually is lower than the LCL or LTL rate.

Lower per unit cost of handling CL or Tl shipments is justified because it is less expensive to handle a vehicle load of the same material/ same destination than to handle two or more different materials carried together in the same vehicle for delivery to multiple destinations.

15.6 Importance of discounts to intermodality

Quantity discounts, container discounts, and their use by middlemen are very important to intermodality. Rate reductions for larger quantities provide an incentive to consolidate shipments, and container rates provide an incentive to containerize freight. Middlemen usually are proficient at performing consolidation and containerization of cargo, making it easier for carriers to transfer cargo between modes. The expanding number of

middlemen, who perform these functions has helped to promote and facilitate intermodality.

15.7 Air Weight Breaks

Since air shipments normally are much smaller than surface shipments, air rate discounts apply usually as " weight breaks " at less-than-planeload quantities, sometimes with additional discounts for containerized airfreight. Discounted planeload rates also exist, and frequently are referred to as " charter " rates, even though service may be provided on a scheduled flight.

15.8 Middlemen and Rate Differentials

Differences in rates according to shipment size have encouraged the rise of middlemen, such as agents, forwards, shippers' associations, brokers, container station operators, non-vessel operating common-carrier by water (NVOCC), and shipping agents. Most middlemen benefit rate differentials when they receive smaller shipments from the original consignor, and then consolidate them into larger shipments for tendering to carriers. These and other. services performed by middlemen are discussed further in Chapter 7.

15.9 Intermodal movements by trail

Today, rail intermodality implies a broad range of service. Piggyback is a popular name or carriage of highway trailers on rail flatcars (TOFC). It can also be applied to containers (COFC) mounted on highway chassis that ride on flatcars. Container service offered without highway chassis on special container cars is not generally considered piggyback, but rail intermodal.

15.10 Piggyback Service

There are 14 basic plans for TOFC/ COFC or piggyback service. (See Table 3 and Chapter 2 sec. Titled *Piggyback Plans 1 through 5* for historical descriptions of how piggyback plans first were promulgated).

Piggyback plans have proliferated impressively from the original four plans to the present fourteen variations. Since passage of the Rail Revitalization and Regulatory Reform Act of 1979, contract rates have mushroomed.

Individual contracts permit water, rail and motor carriers to tailor rate specifications to individual shippers. Fifty percent of intermodal shipments are made through third parties that use volume rates (Table 4)

16. Minibridge rates and the growth of double-stack marine container haulage would have been impossible without contract ratemaking.

Table 3 - TOFC/ COFC Plans

Plan	Type of Service	Designed for	
		Carriers	Shippers
1	Ramp-to-ramp rail handling of motor carrier - and/or rail-furnished trailers in substituted rail-for-highway line-haul service. Motor carrier furnishes pickup and delivery service, charging its published tariff rates for the entire line haul.	√	
2	Complete door-to-door rail-billed fright in rail-furnished trailers, which includes pickup and delivery. Rates are generally competitive with motor carriers' and are sometimes lower.		√
2 ¼	Similar to Plan 2 except the customer provides drayage at (Or Modified either origin or destination but not both. Applicable to a Plan2) limited number of commodities.		
2 ½	Ramp-to-ramp rail-billed freight in rail-furnished trailers. Customer provides both pickup and delivery to and from the rail ramp.	√	√
2 ¾	Ramp-to-ramp service with one rail-owned and shipperowned trailer moving at a two-trailer rate. Pickup and delivery are performed by either the customer or the shipper.	√	√
3	Ramp-to-ramp service with loaded or empty trailers furnished by the customer. Customer provides both pickup and delivery to and from the rail ramp.	√	√
4	Ramp-to-ramp rail service; either customer or railroad can provide trailers or flatcars. In either case, railroad performs only the ramp-to-ramp service. Plan 4 is applicable west of Chicago /E. St. Louis and is often in combination with another TOFC plan in the East on one bill of lading for through movement to and from the West Coast and intermediate points via rail connections.	√	√
5	Door-to-door joint motor-carrier/ rail/ motor-carrier truckload service in trailers furnished by the railroad or motor carrier. Rates are published in rail TOFC tariffs.		√

Plan	Type of Service	Designed for	
		Carriers	Shippers
5¼	Similar to Plan 5 except the customer provides drayage at either origin or destination but not both.		√
5½	Ramp/terminal-to-ramp/ terminal service, under which either rail or motor carrier furnishes the trailer at the railroad or motor carrier terminal location at origin. Customer provides both pickup and delivery to and from the ramp/ terminal.		√
5 LTL	Door-to-door joint motor-carrier/ rail/ motor-carrier LTL service in trailers furnished by the railroad or motor carrier. Origin and destination motor carriers provide pickup and delivery service.		√
6	Railroad trailers are substituted for boxcars (carload) and moved on carload rates (at railroad's discretion).	√	√
7	When permitted by tariff (and subject to approval by origin rail carrier), trailers are substituted for boxcars at the boxcar rate. At destination rail ramp, customer must provide delivery to consignee's facility and return trailers to the ramp.		√
8	U.S. mail on contract rates.		

Table 4 - Estimated International Rail Revenue by Customer Group

Customer Group	Percent of revenue
Shipper agents, forwarders, third Parties	50
Steamship lines	25
Direct shippers	6
UPS	10
U.S. Postal Service	6
Regulated motor carriers	3
Total	100

Source: Trailer Train, Intermodal Market Survey, 1985.

Growth of Piggyback.

Piggyback grew considerably during the late 1950s and early 1960s and leveled during the 1970s. From 1969 to 1977 rail piggyback tonnage grew 40 percent, while rail tonnage dropped 6 percent. Despite increased tonnage, piggyback had not reached forecasted volumes, amounting to less than 1 percent of all intricate freight movement by all modes at the end of its initial growth period.

The following factors contributed to less-than-anticipated volumes:

1. The federal regulatory structure described in Chapter 4 prevented flexibility, and inhibited creative marketing to promote piggyback.
2. Railroads did not aggressively promote piggyback because of regulatory inhibitions, a reluctance to cooperate with truckers, and a perception that piggyback was only marginally profitable.
3. Shippers felt the service was complicated by lack of coordination among modes, and non-competitive in terms of consistent service, lengthy transit times and high damage claims. Poor service for many shippers was the most damaging.

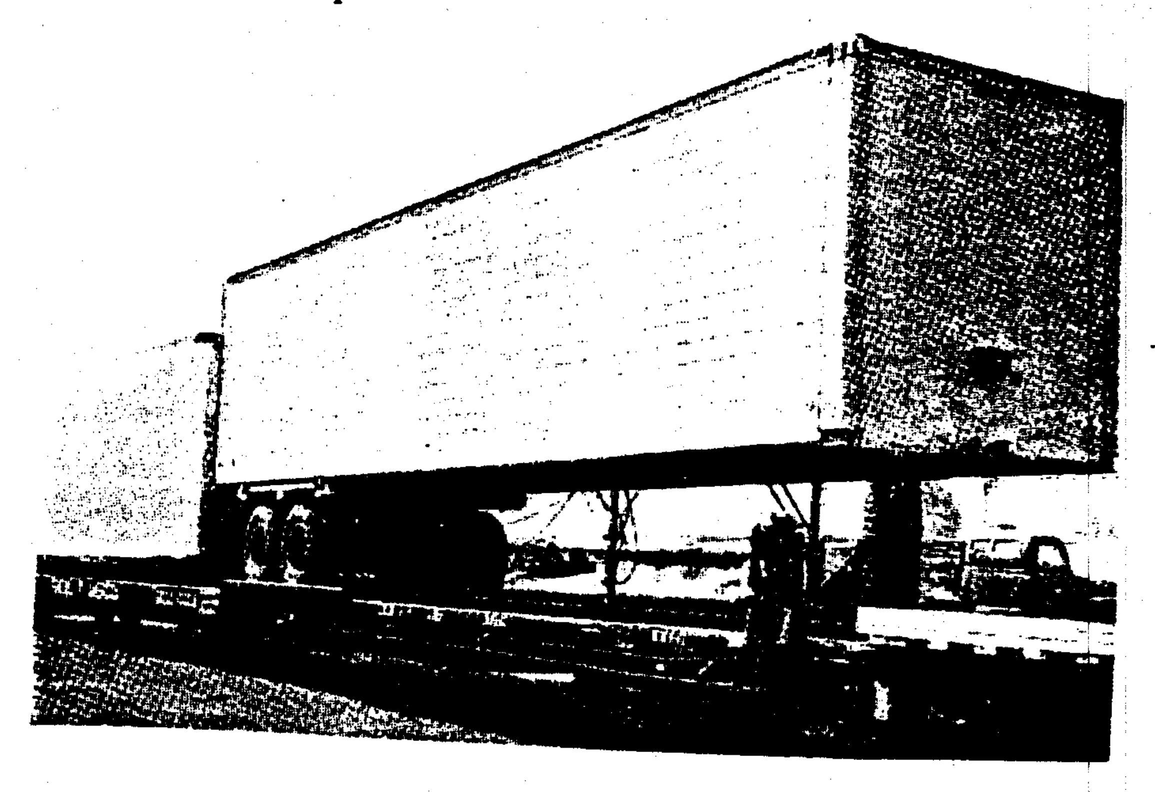
The turning point occurred in 1977 when the deregulatory process began. Carrier inhibitions about cooperating with other modes and lack of promotional enthusiasm for new intermodal piggyback services changed toward greater flexibility starting in 1977. In May 1979, the Interstate Commerce Commission (ICC) deregulated rail rates on fresh fruit and vegetable shipments, which move mostly by piggyback. On March 23, 1981, ICC proceedings entitled Ex Parte No. 230 Sub. 5 became effective, freeing rail piggyback carriage from ICC regulations (see Chapter 4 for details on this proceeding).

These deregulatory moves greatly increased piggyback opportunities.

Additionally, new equipment concepts made intermodalism profitable. Highway fuel and truck tax increases also gave piggyback a slight competitive advantage, but these benefits were more than offset by subsequent liberalization of size and weight limitations for highway motor carriers.

In 1977, piggyback accounted for 7 percent of all rail carloadings. In 1987, 3.4 million piggyback cars carried 5.4 million trailers - a near doubling of the 1.7 million flatcars carrying 2.9 million trailers and containers in 1977. The 1987 figures showed a 7.3 percent increase over 1986. This was not as

impressive as the 20.4 percent increase achieved between 1983 and 1984. Since 1980, however, the year of the Staggers Act, intermodal loadings were up 60 percent. Intermodal traffic comprised 15.2 percent of rail carloadings in 1987, as compared to 7 percent 10 years earlier. Yet, it still constituted less than 4 percent of the total market for containerized freight.



Most U.S. TOFC railcars are 85 feet long and many of the newest are 89 feet long. Here, an 85-foot car carries both a container and a trailer.

CHAPTER 16

16.1 Rail-Truck Hub System Consolidations

The trend toward widespread truck-ıail piggyback services led to a consolidation of interchange points and development of " hub-and -spoke " operations, fanning out truck routes from a reduced number of rail piggyback terminals.

The advantages of hub systems are fourfold:

(1) They increase line-haul density between terminals, thus reducing unit costs;

(2) They reduce the amount of capital invested in terminal real estate on a systemwide basis;

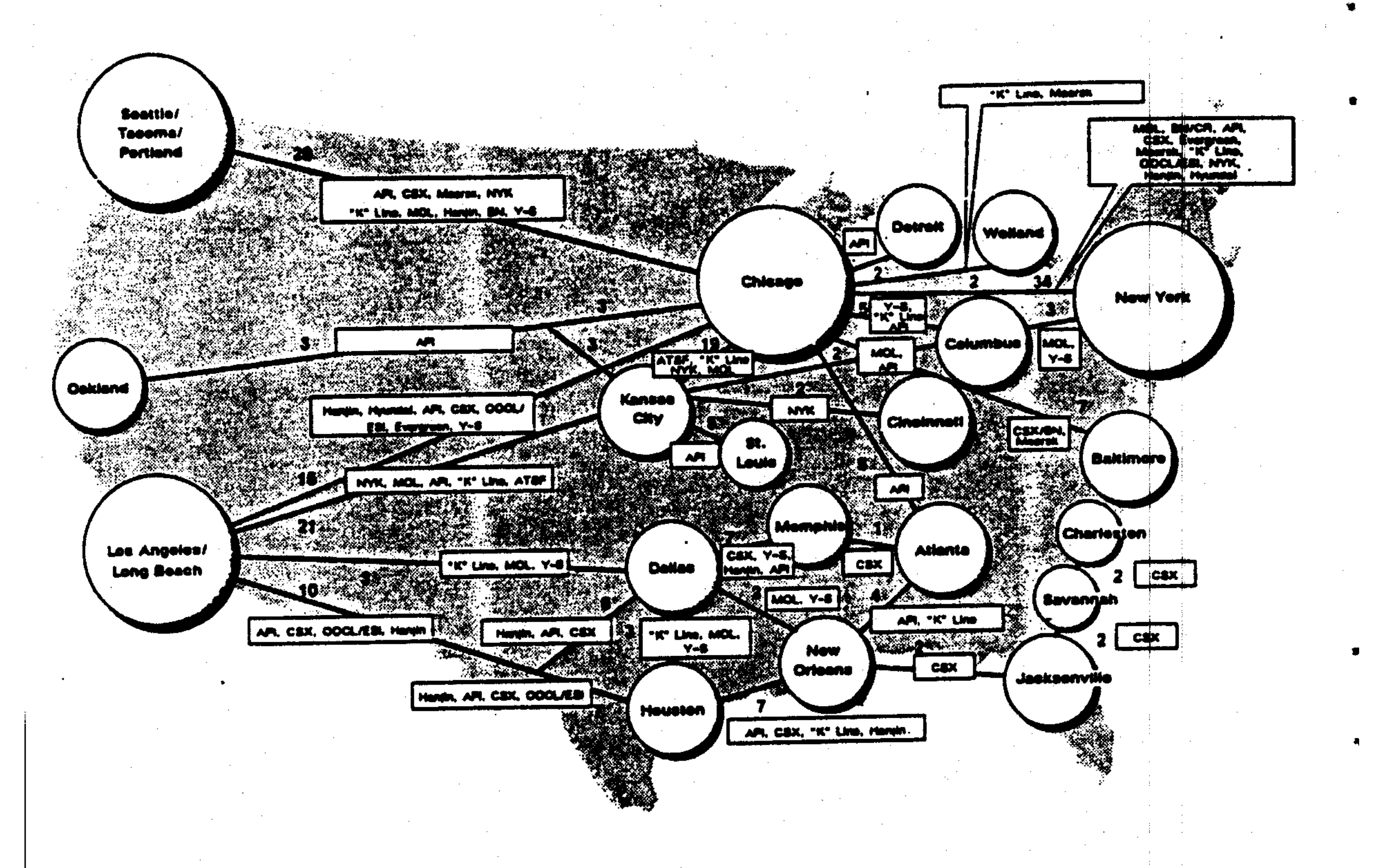
(3) By increasing throughput at a few terminals, mechanization becomes economically feasible, thus unit costs are lowered; and

(4) Service frequently can be improved because there is sufficient volume for additional schedules. The following describes some truck-rail consolidation programs that have been established in recent years.

Atchison,Topeka and Santa Fe Railway.

At a March 1983 meeting of the Intermodal Transportation Association, Larry Cena, then president of the Santa Fe, announced the line's plans to reduce the number of circus-type piggyback ramps. The following month, TOFC terminals were reduced from 96 to 54. Currently, 27 such terminals are in operation.

Six of these hub terminals are part of Santa Fe's quality service network program, which links Albuquerque, Denver, Kansas City (Kansas), Oklahoma City and Phoenix with a system of short, fast, highly reliable piggyback trains. La Junta, Colorado (south of Denver) serves as a true hub, sorting blocks of cars for each destination city. Most runs are completed within 24 hours. Originally, Dallas and Houston, were part of the network, but were dropped when unions decided not to continue with reduced crew agreements, which made such short-haul, high-density service possible.



Major Double-stack services, June 1988 (departures per week, eastbound).
Note: Reflects unit trains and large blocks ranging in size from 50 to over 300 units (FEU).

Source: Temple, Barker & Sloane, Inc.

Canadian National Railway (CN).

While only peripherally affected by piggyback deregulation, CN has steadily reduced the number of TOFC ramps from 137 in 1981 to 6 hubs (Edmonton, Moncton, Montreal, Toronto, Vancouver and Winnipeg) and 4 satellite terminals (Calgary, Halifax, Saskatoon and Windsor). Interestingly, although the density of freight flows are heavier in Eastern Canada than they are in the West, in 1981 CN had as many terminals west of the Great Lakes as in the East. Currently, the only terminal that is not mechanized is Vancouver.

Freightliner.

The intermodal freight subsidiary of British Rail has closed 25 low density terminals in the United Kingdom within the past several years. The eight remaining terminals at Coatbridge, Cardiff, Dangenham (London), Felixstowe, Holyhead, Leeds, Manchester, Swindon, Southhampton, Stockton, Stratford (London), Tilbury, and Willesden (London) are high volume hubs. Each is mechanized with gantry cranes handling only containers (both domestic and international).

Chicago and Northwestern Railways (C&NW).

In July 1984, C&NW operated 28 TOFC terminals throughout its system. In October 1988, James M. Ronayne, assistant vice president -sales and marketing, announced terminal systems would be reduced to just three intermodal terminals. Four were scheduled to be operated by a private terminal company, Rail Intermodal Specialists. Remaining railroad-operated hubs are concentrated at Chicago, Kansas City (Missouri) and St. Paul. The Global I terminal in Chicago is by far the largest, handling only double-stack container traffic, which accounts for 87 percent of C&NW's traffic.

This double-stack service is so popular that just 2 years after opening, Global I exceeded its design capacity, and constructions has stated on a new terminal, Global II.

Chessie System and Seaboard System Railroad (CSX).

The year piggyback was deregulated, the component railroads of CSX and their rail subsidiaries operated 101 TOFC ramps in the Eastern and Southeastern United States. In January 1989, CSX/Sea-Land Intermodal closed 2 terminals, leaving 38 terminals operating. The company estimates $ 40 million will be spent on improvements to remaining terminals and customer service system.

CSX's strategy is to connect its mechanized terminals with direct train service where possible.

16.2 Disadvantages of Hub Consolidations

The hub system of freight movement has grown in popularity in both rail-truck domestic and sea-rail-truck international carriage. The same concept also has invaded domestic and international air-surface transportation. While the hub system has improved service frequency and lowered handling cost due to volume economic, it has several drawbacks. One of these is

distance from customers. With consolidation services, travel patterns become so altered single mode truck service is sometimes more direct. Also, as in the case of Burlington Northern, the expense of truck drayage to the terminal either at origin or destination (or both), the high cost portion of the movement, sometimes can eliminate any line-haul savings from intermodal service. Finally, as pointed out in a study of Conrail's trucking subsidiary (Pennsylvania Truck Lines), productivity is not as great in high volume terminals as it is in lower volume facilities. This supports the same conclusions reached in regard to European terminal size, give today's technology.

16.3 Development of RoadRail

In the late 1950s, the Chesapeake and Ohio Railroad (C&O) (forerunner of today's CSX corporation) developed a new type of rail-highway vehicle. The design consisted of a conventional highway semitrailer with a pair of steel railroad wheels that could be lowered so the trailer could ride on railroad tracks as well. A rather substantial fleet was constructed mainly to haul mail and parcel traffic behind the C&O's passenger trains in Michigan and the upper Midwest. This service lasted until the mid-1960s when passenger train service was largely discontinued. Because the design was proprietary, it was not picked up by another company; although British Rail experimented with the concept in the early 1960s.

In 1977, Robert Reebie acquired the patterns for RoadRailer and, with the help of the original designers Alan Cripe (formerly of CN Rail), Kenneth Brown and Eugene Hindon, re-engineered the original design in a more up-to-date version. The new larger-size version, called Mark II, was operated in revenue service by Conrail (between Buffalo and New York City) and the Illinois Central Gulf (ICG) Railroad. In a later version, Mark IV, the rail axle was moved from behind the trailer's real wheels to in between the rear tandem wheels.

Another version, Mark V consisted of a conventional highway semi-trailer with a front coupler housing and a real coupler slot. This trailer was designed to be driven onto a pair of modified rail trucks (bogies in British parlance).



This is the Mark IV version of RoadRail on rail.

The tandem highway wheels were then raised leaving the rear of the trailer resting on the rail trucks.

This same procedure was followed with the next RoadRail unit. The second unit (now mounted on railroad wheels) would be pushed into the first, so that the coupling housing on the first (or rear) unit would mate with the rear coupling pin and slot on the second, thus forming a train. Mark V offered a distinct advantage over earlier designs: By not carrying around a pair of heavy steel railroad wheels tare weight is reduced by about a ton thus increasing highway payload. The advantage of Mark IV is that rail wheels are attached, and thus there is no problem matching the correct number of RoadRailers with the right number of rail wheels at each location. A mismatch of containers to chassis (caused by variable demand) hindered growth of containerization in its earlier days, and some feel this could occur with the Mark V system.

Beside Conrail and ICG, BN and Santa Fe experimented with RoadRailers. The biggest users to date have been CSX and Norfolk Southern (NS). CSX

operates 250 units between Detroit and Atlanta; NS has the most extensive fleet with 1,750 units in service.

NS's operation is called " Triple Crown, " operating from Detroit to St. Louis and from Chicago to Atlanta and Jacksonville, Florida with Ft. Wayne, Indiana serving as the principal hub at the intersection of both routes.

Because of the early support given the RoadRailer concept by General Motors, it is often thought of in conjunction with auto parts.

Large auto manufacturers are integrating RoadRailer operations into their just-in-time manufacturing plans. However, as the Triple Crown service points out, while auto parts are the principal business, the rest comes from general freight such as paper, metals, consumer goods, beverages, appliances, machinery and plastic products. Thomas Finkbinder, vice president of International and Intermodal Sales notes that revenue rose 900 percent between 1986 and 1988.

Union Pacific (UP) has been operating 175 RoadRails between Chicago and Dallas providing 24 hour service between those points. Up operates its service as a wholesaler selling to truckers, forwarders and third parties. Volumes have grow in this corridor to the point where Up plans to replace the RoadRailer with double-stack service.

The biggest test of RoadRailers viability is a proposed network named " Mark VII. " Mark VII is a carrier concept pioneered by R.C. Matney, founder of National Piggyback Services, the largest third party TOFC operator (before it was acquired by American President Companies).

Mark VII plans to operate an extensive over several railroads from the West Coast to the Midwest and Southeast, using Kansas City as a hub. While Up, NS and CSX all use 48-foot long RoadRailers that are 102 inches wide (the largest size trailer dimension meeting U.S. standards), Matney plans to use 53-foot x 102-inch equipment. These trailers dubbed " Super Wedges " are legal in many states, particularly west of the Mississippi. The advantage of such large equipment is that Mark VII would be able to load the three TEUs into one Super Wedge.

BN has been very supportive of the concept; Matney also has approached NS, Santa Fe and Southern Pacific about providing service within tight schedules. Mark VII offers both cost and service advantages. While truckers might charge $0.92 per mile between Los Angeles and Atlanta, Mark VII believes it can price under $0.85 a mile. It also would provide truck-

competitive transit times. While conventional TOFC service requires 6 days between Los Angeles and Atlanta, Mark VII believes it can do it in 3 days.

Mark VII also plans to provide the latest in electronic data communications, including on-board computers in its own tractors, to provide customers with shipment status and location information.

16.4 Other Carless Technology

The concept of highway trailers mounted on detachable trucks is being tested in the United Kingdom under the auspices of Trailer Train, a subsidiary of Tiger Holdings, who once held the U.S. patents on RoadRailer. The technology is very similar to the Mark V concept modified for the British market.

In Italy, the Breda Railway Group has developed a system of highway semi-trailers with removable rail-road wheels. The bimodal car has been copyrighted as the " bimodale Ferrosnd." A prototype has been constructed and is being tested by the Italian State Railways.

The Strick Corporation of the United States and Sambreet Mense, a French rail equipment manufacturer have joined together to produce a carless technology that uses a highway trailer equipped with corner castings similar to container corner fittings.

In loading, the trailer is set down on a bolster sill that is mounted on a rail truck. The trailer is secured to the bolster by container twist locks. With the addition of an overhead crane, the system also can handle containers. The system's advantage is its tare weight reduction and use of low cost, existing techniques for manufacturing trailers and containers. It is claimed to be 1,000 pounds lighter than competing carless intermodal technology, and is being tested in France.

Railmaster was a competitor of the U.S. RoadRailer, however, in 1987 its patents were acquired by Duchossois Industries, owner of RoadRailer. In concept and design, Railmaster was very similar to RoadRailer Mark V. The Railmaster purchase was made to avoid prospective buyer confusion and to incorporate some of the Railmaster design improvements.

16.5 Carless Technologies-Advantages and Disadvantages

Carless technologies have significant advantages over other types of intermodal equipment. Carless service has low terminal expense. It needs no expensive overhead cranes or piggybackers. The most rudimentary terminal would consist of some gravel spread between the rails so that the equipment could be placed on the track. This could be very advantageous in less developed countries or to exploit temporary sources of traffic.

Secondly, because capital requirements are much less, more terminals located closer to customers could set up. This could lower drayage cost, an important cost component (as high as 30 percent) of short-haul intermodal service.

Thirdly, because RoadRailer and similar technologies operate between dedicated terminals without intermediate handling, loss and damage are reduced. Carless technology also eliminates slack action between freightcars because it does not have traditional freightcar couples. Shippers view loss and damage potential as a significant detriment to rail intermodal services. RoadRailer damage claims experience is much more like truck.

Carless service can operate at much faster speeds than double-stack trains, since it has a lower center of gravity. Because it is a new distinct technology, railroad unions appear more inclined to permit reduced crew sizes on board trains.

On the other hand, carless service does have some drawbacks. It has higher tare weights than highway competition, thus lower payloads. Although total capital cost are claimed to be relatively low (as low as 25 percent below conventional TOFC, because the design does not require investment in cars or expensive terminals), the cost of individual trailers are 2 to 2.5 times higher than conventional over-the-highway or TOFC trailers.

This means RoadRailers need a much higher utilization rate than a typical TOFC trailer gets during the course of a year. Finally, compared to the labor efficiency and lower line-haul costs (less fuel consumed, less capital per train) in high volume, long-haul traffic lanes, double-stack containers have lower unit costs. However, high volume is a necessary prerequisite for double-stack operations to be viable at any length of haul.

16.6 Rail/Truck Bulk Transfers

One of the less noticeable intermodal movements is bulk cargo transfer. While some claim this type of transfer is hardly modern since railroads were dumping coal from hopper cars directly into horse-drawn wagons before the turn of the century, this technology has blossomed in recent years. In the past, transfer between modes was rarely accomplished without some type of intermediate storage. However, with the development of pneumatically operated systems in the late 1950s and early 1960s and the vacuum trailer in the 1970s, direct transfer of small grained bulk products, such as cement, flour, inorganic chemicals and plastic pellets, became a reality. Among the pioneering applications were the Airslide covered hopper developed by General American transportation and the Flexi-Flow Freightcar built by the New York central Railroad (now Conrail). In essence, air is introduced to agitate the cargo while it is sucked out pneumatically by a giant vacuum cleaner.

Although no statistics are kept on this type of transfer, many feel it is growing quite rapidly. In the early 1970s, no more than two rail/truck transfer terminals existed in the New York City metropolitan area; today's there are over ten. Virtually all-larger highway bulk haulers participate in this type of service. Liquids are also frequently pumped from rail tank cars directly into tank trucks. Even short-line railroads handle this traffic-sometimes in its most rudimentary form where covered hoppers are spotted on a highway bridge or abandoned trestle and emptied into a waiting truck. This type of rail/truck transfer offers line-haul economies of rail movement coupled with flexible delivery by truck. The system is a closed loop, therefore product contamination is eliminated. Finally, from the shipper's standpoint, the railcar can serve as storage bin until the product is delivered.

16.7 Bulk Container Transfer

Bulk containers constitute another type of bulk transfer between modes. The number of tank containers has grown rapidly. They come in dry bulk (for pulverized and granular materials) versions, as well as liquid types. There is even a refrigerated tank variant for such commodities as beer and orange juice. For material not equipped to be handled pneumatically, or hydraulically, there are gravity discharge containers. There are also collapsible and disposable containers and liners. Flat racks and open-top high-side containers handle neo-bulks (particularly lumber and steel), not only domestically but internationally as well.

In such bulk transfers, the container can serve as convenient storage at the plant site or in the case of cocking coal, as part of the production process. With extremely toxic or sensitive chemicals, any possibility of contamination is virtually eliminated. Because of the additional tare weight of the container, the highway payload is considerably less than single line rail shipment, or even rail tank/truck transfer, thus raising unit cost per ton-mile.

On the other hand, many frequently shipped bulk materials are so light that the container's weight does not pose a constraint. In the case of international shipments involving several modes from origin to destination, transfer costs are less using containers.

Transloading

Transloading is the practice of breaking (transferring) bulk shipment from the vehicle/ container of one mode (such as a rail boxcar) to that of another (such as a highway semi-trailer) at one or a series of terminal interchange points. Usually, transloading involves transporting a continuous volume of similar products. Computer tracking has enabled accurate monitoring of materials/ products. in transit. This heightened degree of logistics control allows inventories to be created in transit (rolling inventory) rather than maintained in a warehouse or materials yard. transloading is rapidly growing among North American railroads. Union Pacific is hauling canned goods for distribution in the Midwest.

Southern Pacific carriers paper products from the Pacific Northwest to California, and CSX is working with private warehouses to move steel products. Conrail has lumber distribution centers and Steel Net (steel product) warehouses. Santa Fe is starting a chain of warehouses. A rapid upsurge in boxcar traffic has been reported, but transloading can encompass a wide array of rail equipment including: automobile rack cars, mechanical refrigerator cars, flatcars, gondolas and steel coil cars.

Transloading can involve transferring freight between ocean containers and larger dimension domestic containers, or RoadRailers; or from boxcars to ocean containers, as in the case of cotton moving from the Southwest on the Burlington Northern destined to the Far East via Seattle. The rolling inventory technique lowers costs for materials suppliers and product producers, and carriers are scrambling to answer growing demands for this service. With growing specialization of containers and optimal-sized vehicles for various purposes, transloading is bound to grow and prosper.

16.8 International movements by air

Practically all airfreight is intermodal in the sense that pick-up and delivery service is provided by trucks. A substantial amount of airfreight can be classified as intermodal for another reason: it moves via other modes in long-haul transportation. In a long-haul air-surface move, the customer gets the benefit of air speed for a portion of the routing, and of lower surface rates for the other portion. This combination may meet the customer's needs for both on-time delivery and economy.

Growth in Airfreight Cargo

Airfreight cargo is gaining increasing importance in both relative and absolute terms over passenger traffic. In 1955, total cargo and mail carried by the world's airlines amounted to modest 1,300 million revenue tonne-kilometers. Air passenger traffic by comparison was almost 99 percent of total revenue kilometers. International Civil Aviation Organization records for 1986 put revenue tonne-kilometers at 42,900 million-an 8 percent increase over 1985 and a massive 3,300 percent rise since 1955. Airmail volume has grown substantially over the same period, though the rate of increase has slowed in recent years due to world recession and also, in part, to increased use of electronic data transmission and small-package delivery services. Airfreight growth was greatest in the Far East with Hong Kong Airport handling 24 percent more freight in 1986 than the previous year.

Planned Intermodality Helps Airfreight Economics

For airlines to provide economical airfreight service, they must operate with a high percentage of the aircraft's freight capacity filled. Multiple landings and takeoffs to pickup or unload freight is a particularly expensive operating proposition for aircraft. Therefore, airlines arrange to minimize stops, and will try to connect freight to and from airplanes via other modes to assure flight time at near-freight capacity operation. In actual practice, a great deal of airfreight is trucked within North America and Europe, and across national boundaries, to connect with transatlantic airfreighters. (The same occurs in land-sea-movements). Another reason for trucking intermodal air-surface freight within Europe is to meet arrivals and departures of national airlines, each of which is based at a national hub. For example, Air France Hubs at Paris, KLM at Amsterdam, Lufthansa at Frankfurt, etc. Each of these airlines competes in the European market on an intermodal basis in order to provide needed frequency and flexibility.

Trucking across national boundaries to or from an airfreight hub is not as widespread a practice in the Far East as it is in Europe because the geography does not readily permit it. Some of the large Oriental airfreight market are islands like Japan. Hong Kong, Taiwan, and Singapore, limiting feasible air-surface connections.

16.9 Few Intermodal Air-Surface Movements Use Intermodal Containers

In intermodal air-surface transportation whether used for pickup and delivery or long-haul intermodal purposes-the transfer between air and surface modes usually takes place without benefit of intermodal containers. Cargo may be containerized in air containers while it is moving in a surface vehicle, but the cargo usually is transferred in loose form because of the incompatibility of most air and surface containers for carriage in vehicles of the other mode.

An Air Transport Association of America (ATA) study found that among air carriers transporting containers under containers under container tariffs more than 40 percent of their freight volume in 1982 was containerized, up from 33 percent in 1977.

These containers, however, generally were not used for intermodal purposes except within the confines of an airport.

In the 1970s, intermodal air-surface container services started off encouragingly. Hundreds of 8x8x20-foot intermodal air containers were acquired by major airlines. Experiments involving through 8x8x20-foot container movements of air shipments combined with truck, sea and rail piggyback were successful. However, use of these containers for intermodal purposes declined in the 1980s, and today their use in intermodal air shipping is insignificant.

One significant exception was a well-publicized contract that involved General Motors, Alitalia and Lufthansa. In September 1986, both airlines started an airbridge connection to Detroit, making three flights a week with Pininfarina-designed car bodies for Cadillac.

The Boeing 747s carry car bodies in 8x8x20-foot containers on each flight to Detroit, and bring back 90 tons of automobile components on the return journey in the containers.

In another interesting development, salmon and trout are shipped in boxes to the United States from Norway. In 1981, when the program started, Norway exported 80 tons of fish by air.

By 1986, SAS, the principal carrier involved, carried involved, carried over 5,000 tons of seafood to 27 U.S. cities using 8x8x20-foot intermodal containers.

16.10 Factors De-emphasizing Use of Air-Surface Intermodal Containers

The 8x8x20-foot container, with International Standard Organization corner fittings and reinforced floor, is the only true intermodal container because it is compatible with both air and surface vehicles (airplanes, trucks, railcars, etc.). Many airlines, however, have de-emphasized the use of 8x8x20-foot intermodal containers for air-surface transfer because of the following factors.

1. Weight has more critical influence on line-haul costs for air carriers than for carriers in other modes. Container weight sometimes displaces cargo. Extra fuel must be expended to carry the container's weight. On a transatlantic hop, about 1 pound of fuel is expended for each 4 pounds of payload or tare. The 900 percent increase in jet fuel prices during the 1970s had a major effect on intermodal air container economics.

   Although 8x8x20-foot intermodal air containers weigh only 2,200 pounds as compared to 5,00 pounds or more for intermodal surface containers, they still add 21 percent to the weight of airfreight, the average density of which is about 8 pounds per cubic foot. Normally, airfreight is unitized to ease the loading/ unloading process, but it is more economical for the airline to carry freight unitized on a pallet than in a container, because a pallet weighs much less than a container.

2. Intermodal air containers are four to five times more expensive to lease or purchase than surface containers. They are more susceptible to damage because of their lightweight construction, especially when exposed to rough handling in modes other than air.

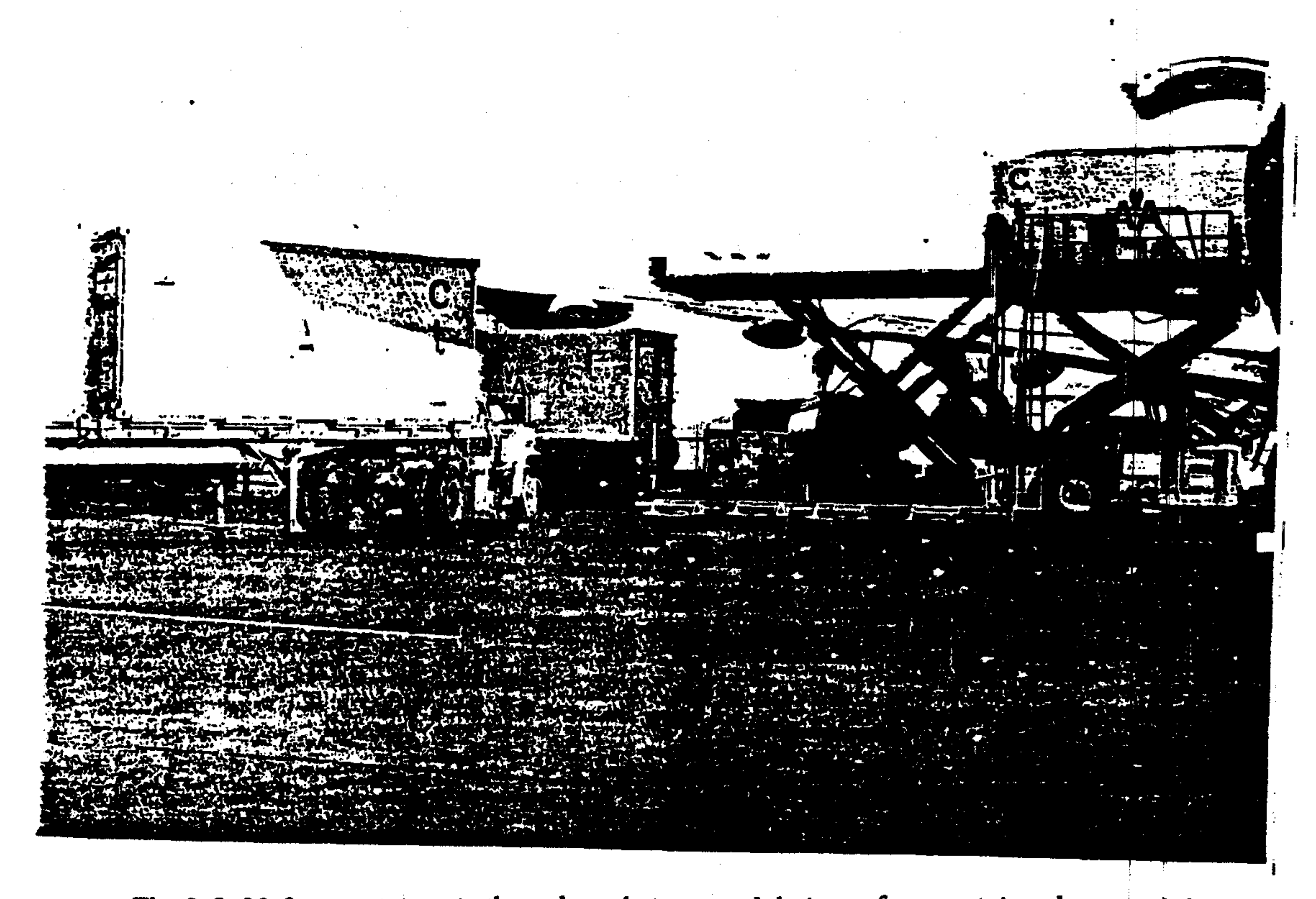
3. The 8x8x20-foot intermodal air containers can be carried efficiently side-by-side only on 747 freighters or 747 combi airplanes with main-deck cargo capability. (They can be accommodated in other models such as the DC-10 with cargo door and floor. However, this is less economical

because containers must be positioned along the center line, wasting space on both sides of the container.)

This limits their use almost exclusively to large main-route aircraft, and makes it difficult to balance container airfreight by direction.

4. If air-surface intermodal containers are to be used in true intermodal fashion in connecting with slower carriers of other modes, their on-line use as airplane containers will be relatively low. Thus, a very large ratio of expensive containers to the number of airplanes operated is needed.

5. Cargo may be stacked as high as 10 feet in the aft two-thirds of the 747 main-deck section, which means that the 8-foot height of the air-surface intermodal container precludes taking advantage of available space inside the plane. This space could be used effectively with a special 10-foot high container but such containers would be unsuitable for intermodal use.



The 8x8x20-foot container is the only truly intermodal air-surface container because it is compatible with both air and surface vehicles.

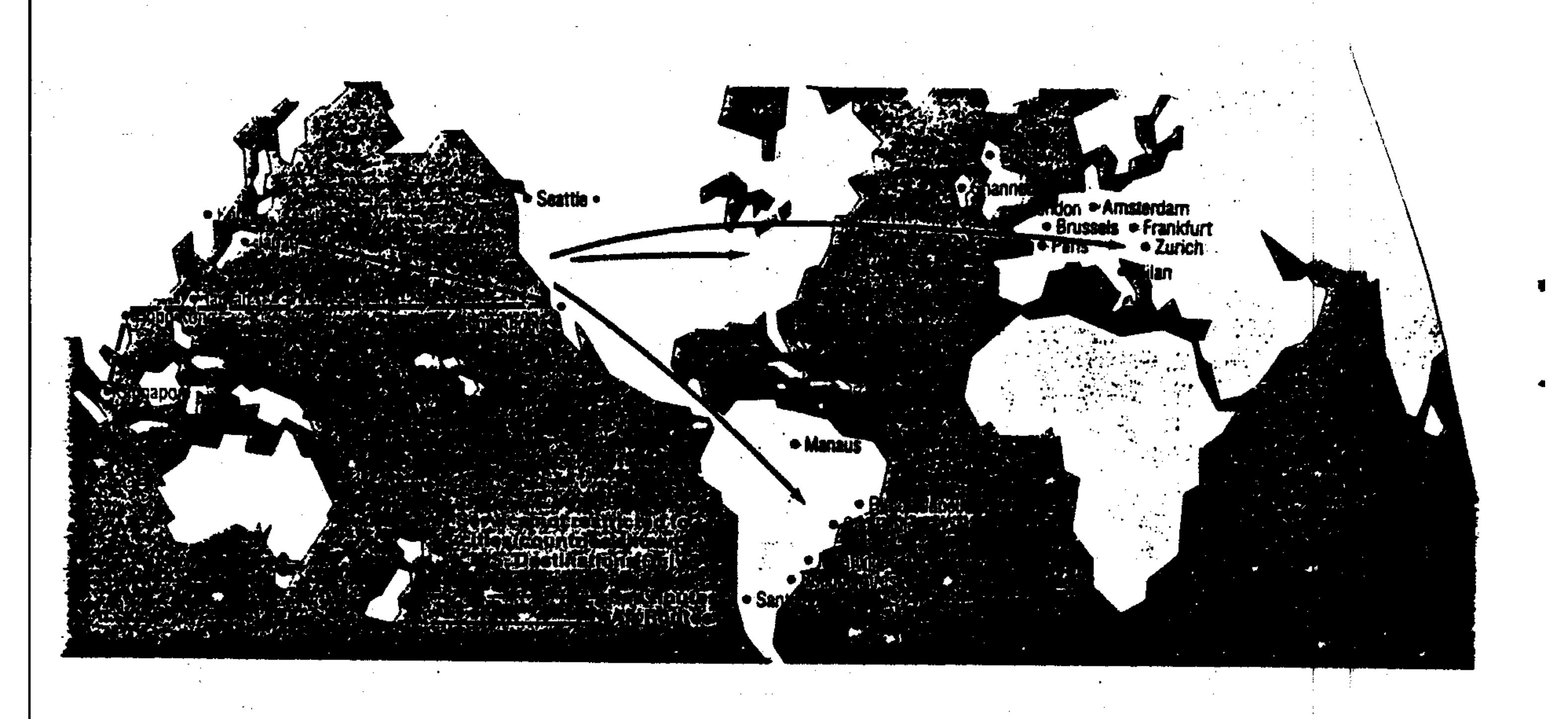
In spite of these factors, the future of 8x8x20-foot intermodal containers for air-surface movement is not as bleak as it may appear. The tare weight disadvantage is applicable to other non-intermodal air containers. Igloo-type containers (Domestic Type A-2, International Types 3), are extremely uneconomical when carried in a 747 freight, because they do not make full use of the stacking height inside the plane. The 10-foot height of the after-deck (rear of plane) of the 747 is required only occasionally. The decision to use an air intermodal container depends on many factors that include relative costs of fuel and labor, and improvements that might be made in capabilities and economic of future airfreighters. For the moment, carrier reluctance and shipper indifference work against the intermodal air container, but this could change with a slight change in one or more of the factors that go into the deciding equation.

16.11 Types of Air Containers

Most air containers have two designations-one for use in the United States and Canada, assigned by the ATA, and one for international use, assigned by the International Air Transport Association (IATA).

The international designation has increased substantially because a number of domestic airlines have become international operators.

Sea Containers by Air. Sea containers have been used to carry loads on 747 airfreighters. This was done in the 1970s by Seaboard World Airlines, when construction and delivery of new air-surface 8x8x20-foot intermodal containers were slow, and there was shipper demand for intermodal container use. At times, Seaboard had as many as 100 sea containers in its container fleet.



Sea Tiger's sea-air route cuts transport time in half.
Source: Flying Tigers.

The use of 8x8x20-foot intermodal sea containers in air transportation to meet peak demand was an expensive proposition for airlines because of their weight, and it became even more expensive as fuel prices increased. The practice was soon discontinued. Sea container had to be strapped to pallets because their surface-container fittings would not permit them to be secured properly in the airplane, which added another 800 pounds of trade to their over 5,000-pound weight. The weight and size of the combined load caused some damage to airplane interior fittings.

Despite these obstacles, Sea Tiger, a service of Flying Tigers introduced a system that eliminated some of the inherent difficulties. Cargo is loaded into marine containers and sealed at point of origin in the Far East. The containers are then transported by containership to Los Angeles/ Long Beach where they are trucked to Flying Tigers' terminal as Los Angeles International Airport. There the freight is loaded into air containers or on pallets and then flown directly to final destinations on 747 jet freighters. Destinations include the United States, Europe and South America.

Types of cargos favored by this system include higher-value, larger volume consumer electronics, automated office equipment and high-technology parts that are less time sensitive than other airfreight

Delivery time is faster (about half the time taken by water and landbridge movement), and cost is about 50 percent less than all-air. Another carrier offering similar service is Air Canada.

16.12 Maximum Size Containers for Existing Aircraft

It is technically feasible to insert an 8x8x40-foot container into a 747 airfreighter through the nose door. However, it is a difficult task because the height of the door is just inches more than 8 feet. The aircraft settles lower on its landing gear when a heavy load is placed in it, thus requiring considerable juggling of long, heavy containers and the height of the loading platform to keep the container level so it will fit through the door. To date, there has been no substantial shipper demand for an 8x8x40-foot intermodal air container. It also would be possible to load an 8x20-foot container with greater height through the side door, which has a 10-foot height.

Intent to Fit Aircraft.

Air containers are designed to make full use of the internal dimensions of the main deck or lower deck space of particular aircraft. This is an important

economic consideration because the line-haul costs of the air mode are a significant aspect of total costs. Air containers are not always compatible for loading aboard another aircraft type. Nor are they generally compatible for loading aboard surface vehicles. The one favorable exception is the 8x8x20-foot intermodal air-surface container, which is compatible with the 747 air-freighter and with the vehicles of various surface modes.

Shipment Smaller By Air.

The average size o general cargo air shipments is much smaller than that of other modes. This is another reason why most air containers are smaller than the 8x8x20-foot intermodal air container, and why they are not well suited for intermodal movement. Air shipments are closely related to LTL and LCL surface shipments. Even when consolidated by airfreight forwarders, consolidated air shipments are smaller in size than those moving via surface modes.

Lower-Deck Containers.

Lower-deck containers and pallets such as the LD-7 (Type 5) and the LD-3 (Type 8) are used for cargo in the lower-deck compartments of passenger or freight airplanes

16.13 Palletization

Since tare weight is saved by using pallets instead of containers, airlines grant a " container " markdown for palletized airfreight, even though the freight technically is not in a container. A compromise for saving tare weight, while using the full contour of the airplane's lower deck, is pallet wings, but these have not received widespread adoption to date.

16.14 Boeing's Intermodal Module Concept

Boeing Air Freight System Development Division has tried to bridge the gap between the intermodal 20-foot air container and the small-shipment characteristics of airfreight. It has developed the intermodal module concept-a family of sturdy, lightweight, inexpensive, and standardized shipping cartons, efficient for use in all modes and readily transferable among air, truck, ship, and rail modes.

Intermodal Module Standards. Three standard sizes of intermodal modules are shown in Table 5.

Table 5 - Intermodal Module Dimensions

Module Designations	L-W-H Dimensions (in inches)
IM 60	55.4 × 43.2 × 60
IM 45	55.4 × 43.2 × 44
IM 30	55.4 × 43.2 × 29

The module length may extend to as much as 57.75 inches, and width may be increased to 45 inches, but no increase in height is permitted.

Advantages of Intermodal Modules. Other advantages of intermodal modules are:

1. They are lighter and less expensive than standard airline containers.
2. They are reusable.
3. They can collapse into compac packages for delivery to a shipper or for repositioning throughout a carrier's system.
4. The lid is designed with a locking-type fastener and with provision for a cargo seal.
5. They are forkliftable.
6. They fit snugly into over-the-road trailers in the United States and a bit more loosely, but still appropriately into the Transport International Routiere (TIR) trailers used in Europe. They also fit snugly into 8x8x20-foot intermodal air containers.

They offer efficient pickup and delivery without unduly delaying trucks for loading and unloading loose freight. In 8x8x20-foot intermodal air containers, the modules offer a means of collecting small shipments from separate shippers prior to air movement and/or distributing small shipments to separate consignees after air movement.

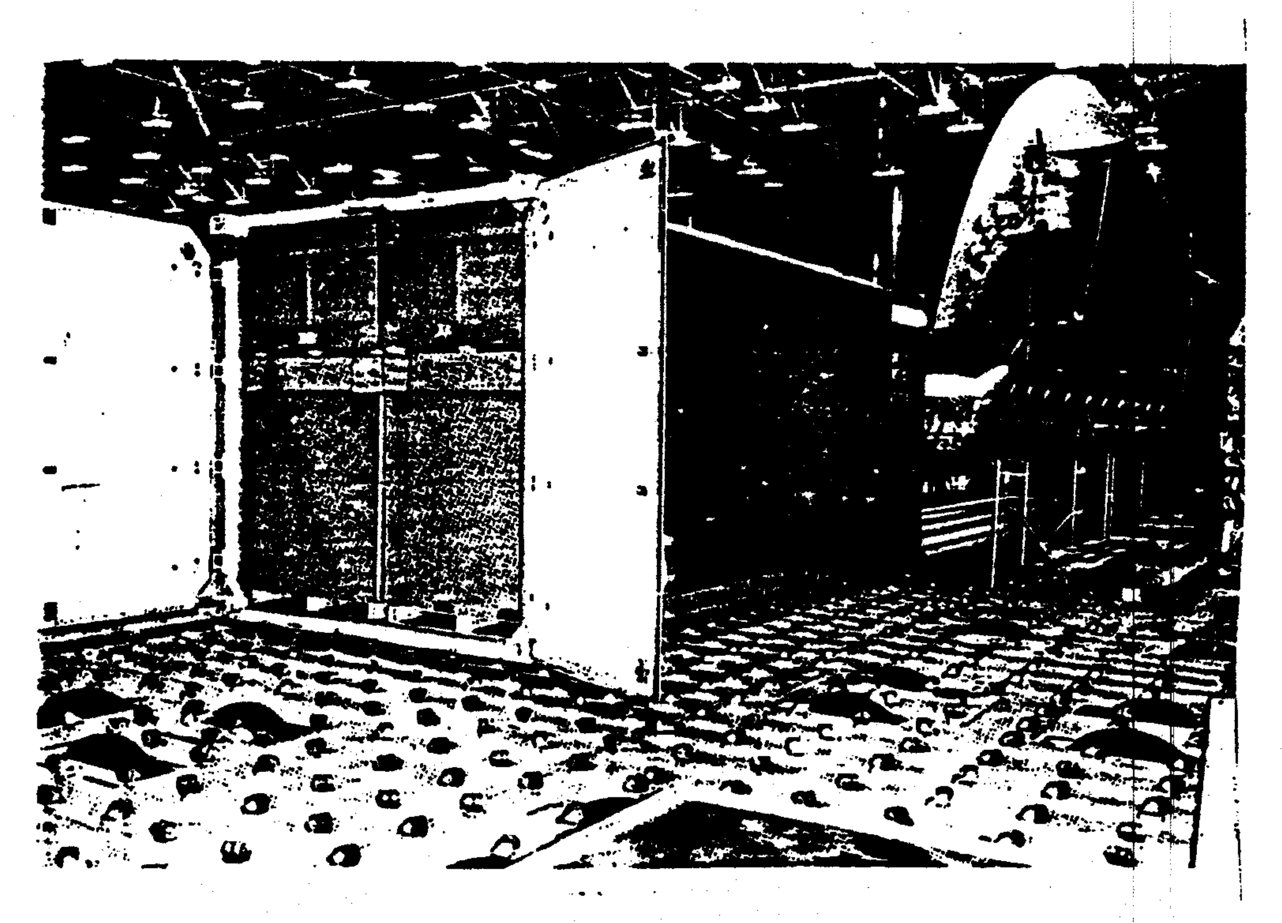
In spite of the many advantages, intermodal modules have not been adopted to any significant extent. Perhaps they have not taken root because the modules are not as durable as metal and plastic pallets and containers normally used by airlines. Whatever the reason, their failure to catch on

again illustrates the fact that containers are rarely used in air-surface intermodal freight transfers.

16.15 Intramodal Transfer

Intermodal transfers are easier to accomplish than intermodal transfers, because vehicles and containers are fairly standard within most modes. For example, it is quite to transfer a boxcar or piggyback flatcar from one train to another, or to transfer a truck trailer from one tractor to another. In contrast, more problems arise in air intermodal transfers than in other modes.

In air transportation the various makes and models of airplanes are of different sizes. The shipper has to know the type of airplane and whether it is a freight, combi, or main deck or lower deck compartment for which he is palletizing or containerizing; otherwise there will be difficulties getting the shipment accepted for a given flight if it is in a container that does not fit that particular type of plane.



Boeing's shipping carton modules inside an intermodal 20-foot air container.

16.16 Smaller Airplanes Become Popular

In the early 1980s, smaller airplanes like the 727-100, 727-200, and the DC-9 became popular for scheduled domestic use as freighters by airlines, airfreight forwarders, and small-package delivery services. (This is not exclusively the case; United Parcel Service bought some DC8-73 and 747 freighter airplanes and federal Express purchased some DC -10s. Both companies also use 727s). Some of the smaller planes placed in service were new, but most were purchased second-hand, converted from passenger to cargo service. (A major exception is UPS' recent purchase of 20 Boeing 757s for small package freight; heavier cargos cannot be carried on this craft because of deck weight limitations). Reasons for the trend to smaller planes were trifold.

1. The market was fragmented among a number of operators, making larger airfreighters such as the 747 and the DC8-63 oversized for market conditions.
2. Development of the small-package market called for smaller planes to serve it most economically.
3. The hub-and-spoke concept gained acceptance as an efficient operating system. It involved smaller units radiating to and from major hubs where they connected with large mainline aircraft. The popularity of these smaller airplanes at a point in time increased demand for particular types of containers to fit their contour and the movement requirements of new types of traffic.

16.17 Hub-and-Spoke Concept

Air carrier management must make two evaluations when instituting a hub-and-spoke connecting service-one intermodal and the other intermodal.

The intermodal evaluation involves comparing costs of various types of aircraft, and deciding how to minimize technical and economic problems of transferring loose or palletized and containerized cargo between aircraft of different sizes.

The intermodal evaluation entails cost comparisons between air and surface modes for various stage lengths, as well as deciding how to minimize technical and economic difficulties of transferring cargo between modes.

16.18 Off-Airport " Cargo Cities "

Cargo in airline containers is transported by truck, but usually only to or from a point on the airport, or very close to the airport. " Cargo cities " have grown up near many major airports, consisting of facilities that rework freight, making cargo compatible for air or surface carriage. The reason for off-airport instead of on-airport facilities is that airport space is limited and expensive, but proximity is advantageous because it is not feasible to truck-air containers for long distances. Some off-airport sites lack the security of on-airport locations, and pilferage and theft is a mounting concern.

Container Stations. Container stations operate in off-airport cargo cities or in other locations in close proximity to the airport. Container stations containerize or " de-containerize " breakbulk freight shipments. Container station rates for containerizing and/or breaking bulk frequently are lower than airline discounts for these practices.

In such instances, it is profitable for the shipper or consignee to pay the container station to do the work, and pay only the discounted price to the airline.

Airlines and Airfreight Forwarders Use Container Stations. Much of the freight tendered to airlines is in loose condition or in consolidations requiring delivery (at destination) by the airline to many separate consignees, possibly 100 or more. An airline terminal usually cannot handle unusual or unexpected peaks of activity, especially those involving consolidation of small shipments or segregation of many small shipments for delivery to individual consignees. For these reasons airlines frequently employ services of a container station.

Airfreight forwarders and other middlemen also use container stations to help during peak periods or to perform tasks for which they are unprepared.

16.19 Middlemen Facilitate Air Intermodal Process

Middlemen are of special interest in connection with air-surface Intermodality. They facilitate the intermodal process with delivery services, by consolidating and performing breakbulk services, by operating container stations, and by coordinating movement of freight via several modes.

Airfreight forwarders, for example, are permitted more latitude by the federal government in their operations than surface forwarders. Their intercontinental operations are more akin to NVOCs than ocean forwarders.

(The air cargo agent classification has never existed in the domestic field because airlines have never authorized commissions for domestic cargo transportation).

Prior to airfreight deregulation, there were strict federal delineations between international air cargo agents and airfreight forwarders, and between domestic and international airfreight forwarders.

International air cargo agents could receive commissions from airlines but not consolidate shipments, whereas international airfreight forwarders could consolidation shipments but not receive commissions. International air cargo agents were agents of the airlines and international airfreight forwarders were " indirect carriers", the latter holding the relationship of shipper to the airlines (not their agent), and of a carrier to the shipper. International air cargo agents could sell only at rates published in the airline's tariff, but international airfreight forwarders published their own rates, either higher or lower than those of the airline.

International air cargo agents made money from airline commissions, while airfreight forwarders profited from airlines weight-break discounts. Both international air cargo agents and international airfreight forwarders charged shippers for ancillary services such as export or import documentation. To become an international air cargo agent, applicants had to meet IATA requirements. To become an international U.S. airfreight forwarder, applicants had to meet Civil Aeronautics Board (CAB) requirements.

The rigid distinctions between international cargo agents and international airfreight forwarders began to erode even before deregulation.

In order to obtain commissions on single shipments while being able to act as an airfreight forwarder on consolidated shipments, many forwarders also became international air cargo agents. However, for a long time U.S. federal authorities would not let airfreight forwarders in the United States receive a commission from airlines on consolidated shipments. These companies had to keep agency and consolidation shipments segregated, receiving only a commissions on one type and benefiting only from weight break on the other.

Air Middlemen in other Countries Cause Changes. Outside the United States and Canada there was no such thing as separated air cargo agents and airfreight forwarders. The middleman was a consolidator, and there was no prohibition against receiving commissions from airlines on consolidated shipments. For several years an imbalance existed: one set of rules applied

to U.S. inbound traffic, and another, more restrictive, set applied to U.S. outbound traffic. The CAB was pressured to permit commissions to airfreight forwarders on consolidated outbound shipments. While petitions were being field with the CAB, and while proceedings started to investigated the situation leading to relaxation, many airfreight forwarders established their own agency subsidiaries, usually under a different company name. In this way airfreight forwarders could avoid federal restrictions by consolidating in the name of the airfreight forwarding company, and then turning the consolidated shipment over to the parent company o get the commission, as well as benefit of consolidation.

Solution through Deregulation. This unstable situation ended with permission for commissions on outbound (as well as inbound) consolidated shipments, and easing of entry requirements for U.S. airfreight forwarder certification. The airfreight forwarder application form now is very simple, listing only basic minimum fitness requirements and no " public convenience and necessity " requirements. Within recent years the filing has jumped from $ 15 to around $ 2,000. A single certificate covers both domestic and international authority. The result has been a tremendous increase in number of airfreight forwarders certificated in the United States, boosting intermodal air-surface transportation.

Deregulation has increased activities of forwarders and other middlemen. Some actually have become direct air and truck carriers, as explained in Chapter 4. Some airlines, truckers, and railroads have taken on door-to-door functions previously performed by middlemen. These moves have encouraged intermodality and have given the consumer a wider range of rate and service options.

Much speculation has focused on the future of small airfreight forwarders, especially when considering competition from well-resourced giant forwarders, including those providing full service door-to-door operations and ultramodern communications.

These small firms constitute 85 percent of the forwarding industry. The answer lies with their ability to become highly sensitive to their customers' needs, including 24-hours access to information and assistance, and reacting quickly in situations where human application can solve a problem where the computer cannot. For the small forwarder to survive, it must know its clientele's special needs and operating circumstances.

16.20. Small Package Air-Surface Delivery

The small-package air-surface delivery business is a new and growing aspect of air intermodal transportation. This business moves more air shipments daily in the United States than the scheduled airlines themselves. In 1983, small-package delivery services moved over 50 million packages every business day. Up to 1986, business continued to grow at a phenomenal annual rate of 20 to 30 percent, while other segments of air and surface freight transportation suffered from lack of demand. Not only was this growth rate experienced by small-package carriers already in business, but also by the steady stream of newcomers who garnered enough business to gain a foothold and expand.

In 1987 and 1988, growth declined slightly to about 15 percent annually.

Only in America does such an extensive array of small-package air delivery systems exist. These services carry large volumes of documents, spare parts, gifts, merchandise, and other small but timesensitive items to satisfy nationwide demand for speedy delivery.

Wide Range of Operators. The small-package air express business consists of a wide range of operators. There are large, old-line, longstanding small-package delivery companies like UPS. UPS is the world's largest privately-owned transportation company; its air service represents a small fraction of its total business, even though it ranks as one of the largest air express carriers. It flies to 82 countries and its fleet includes around 270 aircraft.

There are small package air delivery specialists like the giant Federal Express, which has grown rapidly from a standing start in 1973. Airfreight forwarders like Emery, which was the first in the airfreight forwarding business, are integrated cargo, courier and express delivery companies.

There are scheduled airlines like Flying Tigers and others, providing door-to-door express delivery to capture traffic that otherwise would have slipped from their hands and also to raise their average yield with the admixture of high-rated small-package express traffic.

There are passenger airlines like Eastern, Delta, and many others, offering a passenger-ticket-counter to passenger-ticket-counter service, in which express packages are carried with passenger baggage. There are courier services that can send a courier to ride with the shipment or provide couriers at each end of the air movement.

Many miscellaneous small operators and new entrants have been drawn to the profit potential of the growing small-package express business, including some U.S. trucklines experienced in LTL movements. A " shakeout " of the industry is still underway resulting in fewer but largest specialists. The industry epitomizes intermodality in its fastest-moving state.

Major companies in the small-package air delivery business usually are characterized by an integrated intermodal and intermodal hub-and-spoke system. They use more trucks than airplanes, although their sales promotion emphasizes the speed of air.

This is a business that was able to break free of its bonds with deregulation, and has grown rapidly with intermodality, the hub-and-spoke concept, and the latest technical advances in computers and electronic communications.

Hub-and-Spoke Small-Package Delivery Examples.

Prior to entering the air business, UPS had long used a series of hub-and-spoke trucking terminals to deliver intermodal freight to and from piggyback hubs. It now uses the same system with trucks to deliver to its air hubs, the largest one in Louisville, Kentucky. Federal Express has a major hub in Memphis, Tennessee, and a series of secondary intermodal hubs for pickup and delivery throughout the country. Emery's major air hub is in Dayton, Ohio; Airborne's is in Wilmington, Ohio.

Small-package sorting systems used at hub stations have been on the leading edge of technical expertise, and improvements are continuous.

International Small-Package Delivery and Courier Services. Small-package delivery services are developing on international air routes, and courier-type services are leading the way. Courier services clear customs more easily by having shipments declared as baggage. In developing countries, courier-type service overcomes the fact that a street name and address numbering system may not be fully operational for ordinary mailing purposes.

Three major hurdles to a U.S. -type expansion of international small-package express are:

(1) Difficulty of clearing customs with a large number o small package;

(2) Opposition by some postal authorities, who would prefer small-package traffic to move in the postal system; and

(3) Government-supported national airlines opposed to competition, especially when it might divert traffic from their routes via an intermodal hub. On the other hand, expedited services are needed because international mail is slow and customs technicalities delay many small airfreight shipments.

The small-package air express system, which in recent years has become an integral part of the U.S. domestic intermodal transportation network, undoubtedly will continue to expand along international routes.

Table 6 - Types Ocean Vessels in Operation

World Fleet Tonnage	*1986*	*1987*
Oil tankers	38%	38.3%
Liquedfied gas carriers	1.6%	1.6%
Ore and Bulk carriers	30.1%	30.1%
Mixed bulk/ ore carriers	6.0%	6.2%
General cargo carriers	16 0%	15.7%
Containerships	3.3%	3.6%

Source: Journal of Commerce.

CHAPTER 17

INTERMODAL MOVEMENTS BY OCEAN

The nature of goods to be transported, and their intermodal requirements and limitations, usually determine the type of ocean vessel used (see Table 6). Most general cargo on major routes is moved in containers aboard containerships. However, port limitations, including container handling capabilities, transhipment requirements, size of pieces, and other factors affect the decision on type of vessel used.

17.1 Containerships

Containerships carry general cargo in intermodal containers that can be transferred between vessel and truck, rail or air. Containership operation is a very efficient ocean transport method for general cargo. It permits fast vessel turnaround, allowing operators to achieve maximum vessel utilization. The intermodal aspect of the container is very useful to shippers, and containership operation suits their requirements for speed, efficiency, security and low cost (see Table 7).

Table 7 - Summary of World Containership Fleet by Size and Type (November 1, 1987).

	Under 500	*500-999*	*1,000-1,499*	*1,500-1,999*	*2,000-2,499*	*2,500+*	*Total TEU (Total Ships)*
Fully cellular							
Present world slots	106,940	160,030	206,279	250,858	172,915	409,463	1,296,480
(number of ships)	(371)	(206)	(168)	(145)	(76)	(137)	(1,103)
Slots on order	2,527	4,460	12,252	16,777	16,424	108,980	161,420
(number of ships)	(7)	(6)	(10)	(10)	(8)	(35)	(76)
Converted to cellular							
Present world slots	8,875	38,844	59,184	4,722	8,000	—	119,625
(number of ships)	(38)	(56)	(50)	(3)	(4)	—	(151)
Ro-Ro/Container							
Present world slots	22,094	18,:70	22,029	17,543	8,200	14,659	102,595
(number of ships)	(70)	(30)	(18)	(10)	(4)	(5)	(137)
Ro-Ro							
Present world slots	88,493	68,376	53,169	22,128	11,673	—	243,839
(number of ships)	(360)	(107)	(42)	(13)	(5)	—	(527)
Slots on order	3,910	7,565	—	—	—	—	11,475
(number of ships)	(12)	(10)	—	—	—	—	(22)
Semi-container							
Present world slots	385,787	193,868	16,825	—	—	—	596,480
(number of ships)	(1,470)	(301)	(15)	—	—	—	(1,786)
Slots on order	7,934	9,166	—	—	—	—	17,100
(number of ships)	(29)	(15)	—	—	—	—	(44)
Breakbulk							
Present world slots	40,611	—	—	—	—	—	40,611
(number of ships)	(233)	—	—	—	—	—	(233)
Bulk/Container							
Present world slots	21,470	82,060	106,341	82,030	12,545	—	304,446
(number of ships)	(62)	(113)	(86)	(50)	(6)	—	(317)
Slots on order	—	—	—	—	8,276	—	8,276
(number of ships)	—	—	—	—	(4)	—	(4)
Barge carriers							
Present world slots	2,468	10,648	2,947	3,104	—	—	19,157
(number of ships)	(7)	(17)	(2)	(2)	—	—	(28)
Total							
Present world slots	676,728	561,996	466,774	380,386	213,333	424,022	2,723,238
(number of ships)	(2,611)	(830)	(381)	(223)	(95)	(142)	(4,282)
Slots on order	14,371	21,191	12,252	16,777	24,700	108,980	198,271
(number of ships)	(48)	(31)	(10)	(10)	(12)	(35)	(146)

Source: *Containerization International Yearbook 1988.*

17.2 Fully Cellular Containers.

Fully cellular containerships carry containers, but have no provision for carrying containers on chassis or for carrying any non-containerized cargo. Carriage of containers sometimes is referred to as lo-lo (load on-load off) when compared to the ro-ro (roll on-roll off) system.

Table 8 - World Fleet of Very Large Containerships
(Recent buildings of 3,000 TEU or greater) a

Company	Country	Capacity Per Ship In TEU)	Number of Ships	Year in Service
U.S. Line b	USA	4,458	12	1984 - 85
American President Lines c	USA	3,900	5	1988
Evergreen Marine Corp c	Taiwan	3,428	11	1987 - 88
Maersk Line c	Denmark	3,386	6	1988
Yang Ming Line	Taiwan	3,042	8	1986 - 87
" K ' Line	Japan	3,000	7	1986 - 87
Orient Overseas Container Line	Hong Kong	3,000	5	1987
NYK Line	Japan	3,000	3	1987
Neptune Orient Line	Singapore	3,000	2	1986

a Twenty -foot container equivalent units (TEUs).
b Vessels owned and operated before filing for bankruptcy in 1987.
c Vessels currently on order and/ or under construction.

Source: Temple, Barker & Sloane, INC. The Wall Street Journal, June 16, 1987.

In 1986,an estimated 4,000 container vessels, capable of carrying 2.6 million TEUs (twenty foot equivalent units), were in operation. Individual vessel sizes range from less than 100 TEUs, which are used mainly for coastal and Panama Canal services, to those of the post-Panamax size with carrying capacity as much as 4,458 TEUs. Post-Panamax vessels cannot pass through the Panama Canal, which has a vessel beam limitation of 105 feet, and must therefore rely on speed and connections with high-volume intermodal services at one or more ports at either end of the voyage. As of 1987, larger TEU carriers included American President Lines and Evergreen (see Table 8). In 1986, U.S. Lines built 12 of the world's largest containerships, each capable of carrying 4,458 TEUs. However, shortly after their introduction the company went bankrupt and most of the vessels were sold to Sea-Land and were no longer carrying their full TEU capacity.

Except for special instances, containerships are captive to ports that have adequate marine container handling facilities, including container cranes that reach as high as 152 feet to reach all container slots aboard post-Panamax vessels.

Ro-Ro Vessels. RO-ro vessels are built to accommodate general cargo on wheels; cargo is moved on and off the vessel on wheels attached to the cargo. During the sea voyage, cargo remains on its wheeled chassis and is secured to the vessel by tiedown and/or locking mechanisms. Ro-ro vessels accommodate containerized cargo (on wheeled chassis) and also sorts of wheeled vehicles and outsized cargo on wheels or wheeled platforms, such as automobiles, tractors, mining, and agricultural machinery.

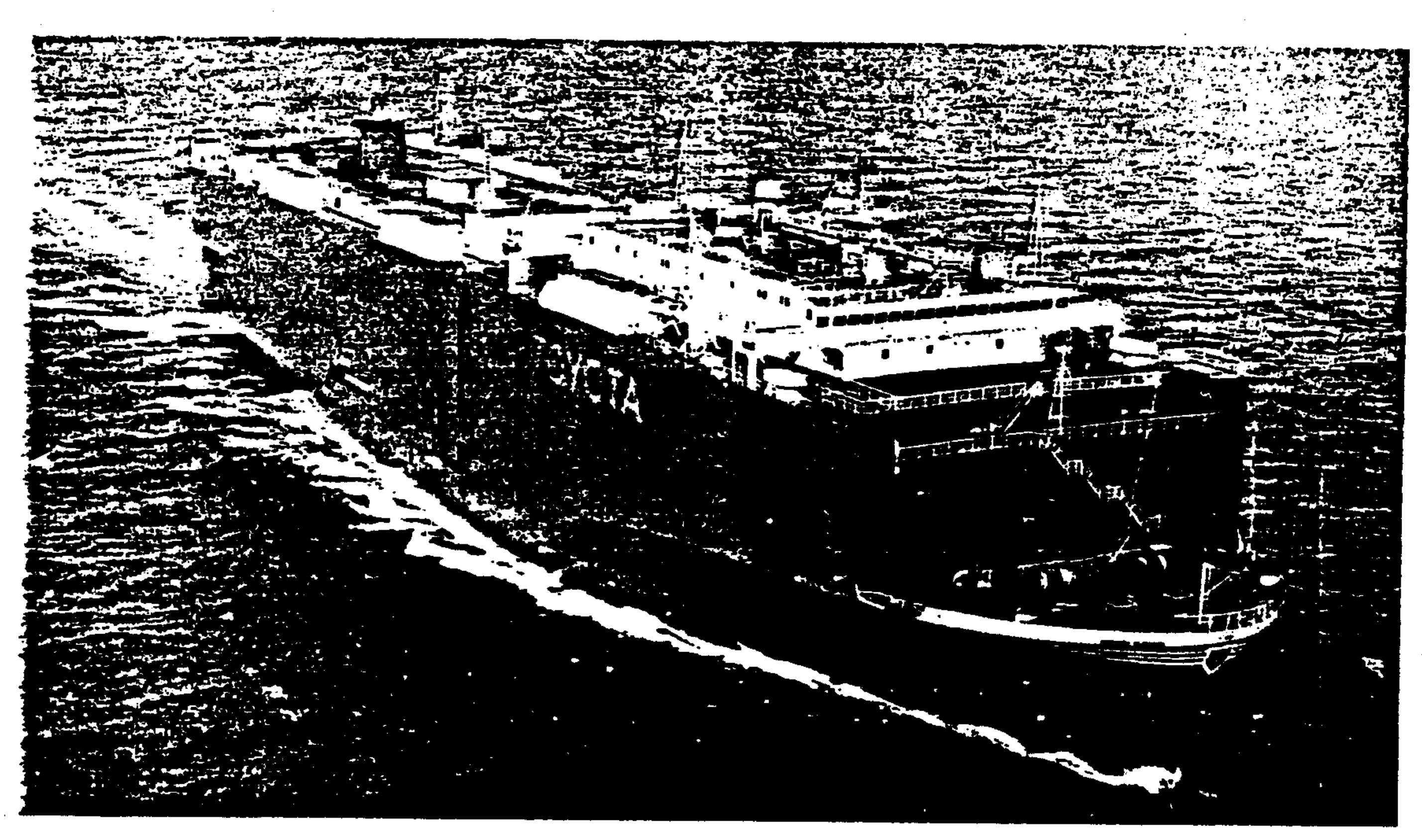
There is continuing debate regarding the merits of ro-ro and lo-lo. Ship designs in both categories, as well as port handling methods, are steadily improving. Use of combination ro-ro/lo-lo vessels is increasing in an attempt to incorporate the benefits of both systems into one. The following circumstances might cause a ro-ro operation to be performed on either an exclusive or combinations basis.

1. *Where port facilities are not equipped with cranes and other machinery to load and unload ships.* In these cases the ro-ro operator simply lowers or places a ramp between ship and pier, and rolls cargo off and on the vessel. This makes ro-ro especially helpful in LDCs.
2. *Where there is a volume of outsized cargo.* This type of cargo is easily rolled on and off; and ro-ro's have greater normal capacity, along with moveable bulkheads to create more space for outsized pieces. Ability to

carry outsized pieces and containerized cargo gives ro-ro operators a wider range of customers - those with containerized cargo, those with outsized pieces, and those with both.

3. *Where there is a military requirement.* The armed services were early supporters of ro-ro vessels because they can accommodate large military vehicles such as tanks, cannons, and troop carriers, as well as bulk supplies for support purposes. An ocean shipping company desiring a military contract has an advantage with a ro-ro vessel.

4. In a multiport operation. Ro-ro vessels provide flexibility for moving cargo on and off at intermediate ports while simultaneously allowing movement of cargo within the ship to adjust for changed cargo " mix ". This can reduce time in port to improve ship utilization, a very important consideration.



Ro-Ro vessels accommodate general cargo on wheels or containerized cargo on wheeled chassis.

Photo courtesy of Overseas Shipholding Group, Inc.

5. *Where there is port congestion*. Most ro-ro vessels can back (or nose) into a pier, taking up little space, and then discharge and load quickly without tying up port equipment or facilities. This advantage has faded somewhat in important since most Middle East and African ports have become less congested.

6. *In an effort to obtain higher rates on some commodities.* Ro-ro's attract better rates of freight for their specialty, rolling cargo, than for goods that any container line could handle. For easily block-stowed commodities like wool, rubber or forest products, the " Stow-Ro " concept makes high-cost container stuffing, handling, and stripping inefficient.

7. *On domestic routes where short water trips are combined with truck hauls*. The ro-ro system provides fast vessel loading and discharge, combined with fast through intermodal movement - unhampered by customs delays because it is domestic transportation. Two examples are U.S. Puerto Rico and Pacific Northwest -Alaska.

8. To speed vessel turnaround. When the entire on/off load is mobile, a ro-ro ship can make a relatively fast port turnaround.

On the other hand, there are two major disadvantages:

(1) Space inefficiency because of extra room needed for chassis, wheels and outsized cargo; and,

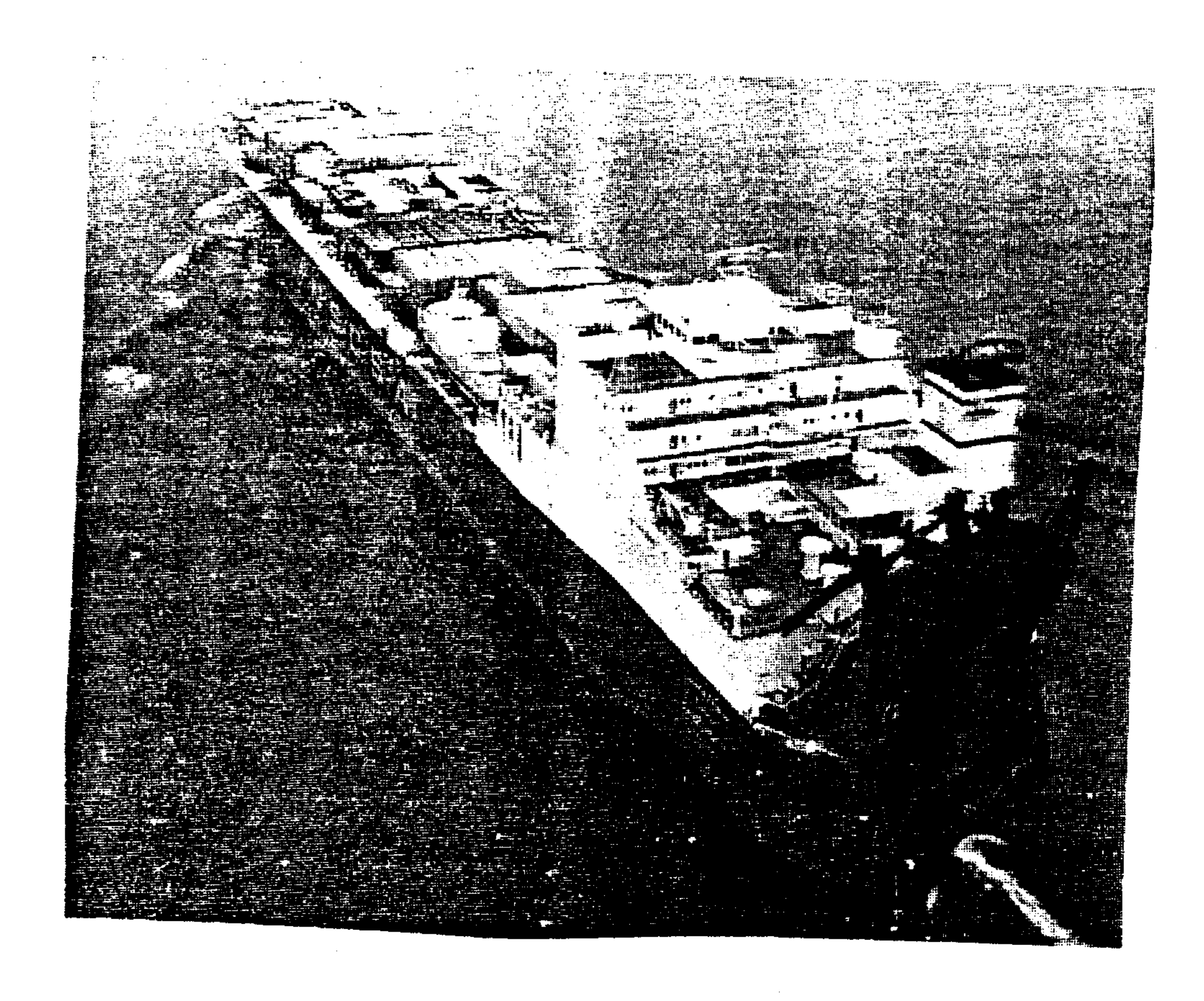
(2) Ship safety. Both of these disadvantages are receiving increasing attention in ship design.

Combined Ro-Ro / Cellular Containerships.

Combined ro-ro / cellular containerships handle both containers and wheeled cargo. Since they accept all types of cargo, they can accommodate more cargo in a single port call than a more specialized vessel. Further reductions in port turnaround times may be achieved by loading simultaneously with both systems - containers being placed aboard by crane while wheeled traffic flows via the loading ramp. The same principle applies to unloading.

" Harmonization, " another name for this type of service, implies operating and marketing flexibility beyond just a combination of the two systems. Some shipping consultants predict that the ro-ro system will be useful on most trade routes, and that most future vessels will accommodate a mix of ro-ro cargo and containers. Some of the largest ships built in the early 1980s

were fitted to accommodate both containers and ro-ro cargo because it was feared there might not be enough of a single type of cargo availale at one time to fill such a large ship.



Combination Ro-Ro and containership accommodates both containers and wheeled cargo.

Source: Via Port of NY/ NJ, April 1988.

17.3 LASH (Lighter Aboard Ship) Vessels

LASH ships carry barges. Cargo is loaded into barges at origin; the barges then move under their own power or are towed to the LASH vessel and lifted aboard. The LASH vessel carries the barges to an overseas port where they are taken off the LASH vessel, and proceed under their own power, or by tow, to final destination.

For example, cargo may be loaded on a barge in Pittsburgh, from which point it proceeds along the Ohio and Mississippi River system to New Orleans, where it is lifted aboard an ocean-going LASH vessel. The LASH vessel carries the barge to Rotterdam where it is taken off the LASH vessel and moved along the Rhine River to Cologne, Germany, its final destination.

LASH vessels can accept a wide range of cargo-bulk, general, outsized, containerized, and breakbulk. Rates are low where all-water transportation is available. LASH vessels are especially useful in two circumstances:

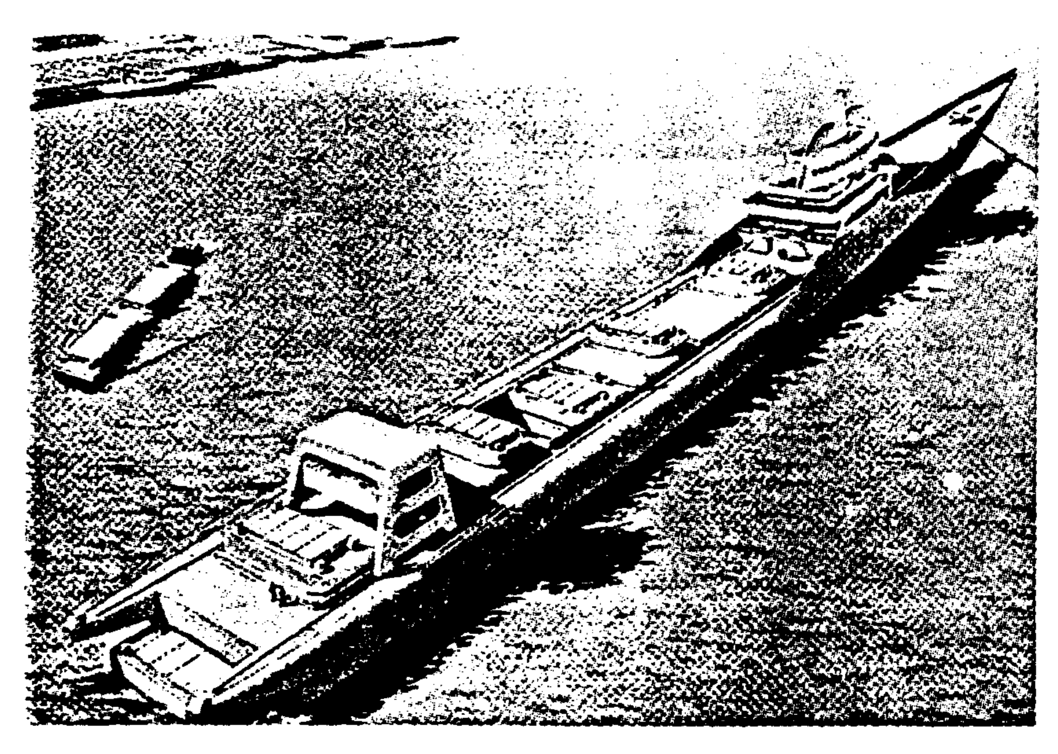
(1) Where an ocean port has water connections with its hinterland via river, canal, or -sea; and

(2) Where port facilities are not sufficiently develop to permit direct loading or unloading of a large ship. The former describes ports like New Orleans, Rotterdam, and Istanbul.

LASH shipments transiting these ports avoid freight port handling, and require use of few port facilities. LASH vessels are self-contained and self-sufficient, loading and discharging their own barges. This is especially important in many small undeveloped ports of West Africa and South America that lack facilities for unloading containers. Furthermore, a through onboard bill of lading to final destinations may be issued when the goods are loaded on barges at origin cities.

LASH vessels can accommodate containers either on barges or directly. This permits cargo mix and operating flexibility. LASH flexibility extends beyond methods of carrying general cargo to bulk cargo. LASH operators feel they are fully competitive against some of the ocean bulk carriers, especially where carriage is to or from interior points served by waterways. In early 1981, the FMC proposed that LASH carriers tariffs for bulk cargo loaded into containers and other intermodal equipment. This was hotly contested by LASH carriers on the basis that such filing would allow competing bulk carriers to see their rates before bid openings, and would let

bulk carriers underbid them. Competition by LASH carriers for bulk as well as general cargo is intense.



LASH ships offer unique flexibility. The barges (lighters carried aboard the LASH ships can be used to carry any combination of containerized, breakbulk or bulk cargo.

17.4 Combination Containership / LASH Ocean Vessels

Some shipping lines, like Rhein Maas and See GMBH of Germany and Lykes Lines of the United States, have acquired combination container / LASH vessels in order to meet requirements of a few shippers who want specialized LASH service, while at the same time remaining competitive in containership trades. These hybrid vessels are very much in the minority, and the future of this kind of ship in liner service is in question.

17.5 Containers and Passengers

A/S Ivarans Rederi, a Norwegian shipping company, has recently started an unusual service that combines a containership with a cruise ship. Each of their new ships carries 1,120 TEUs and 100 passengers with a crew of 44 on a route between the U.S. East Coast and the east coast of South America. Roundtrip passenger fare between New York and Buenos Aires is $ 9,375 (1989).

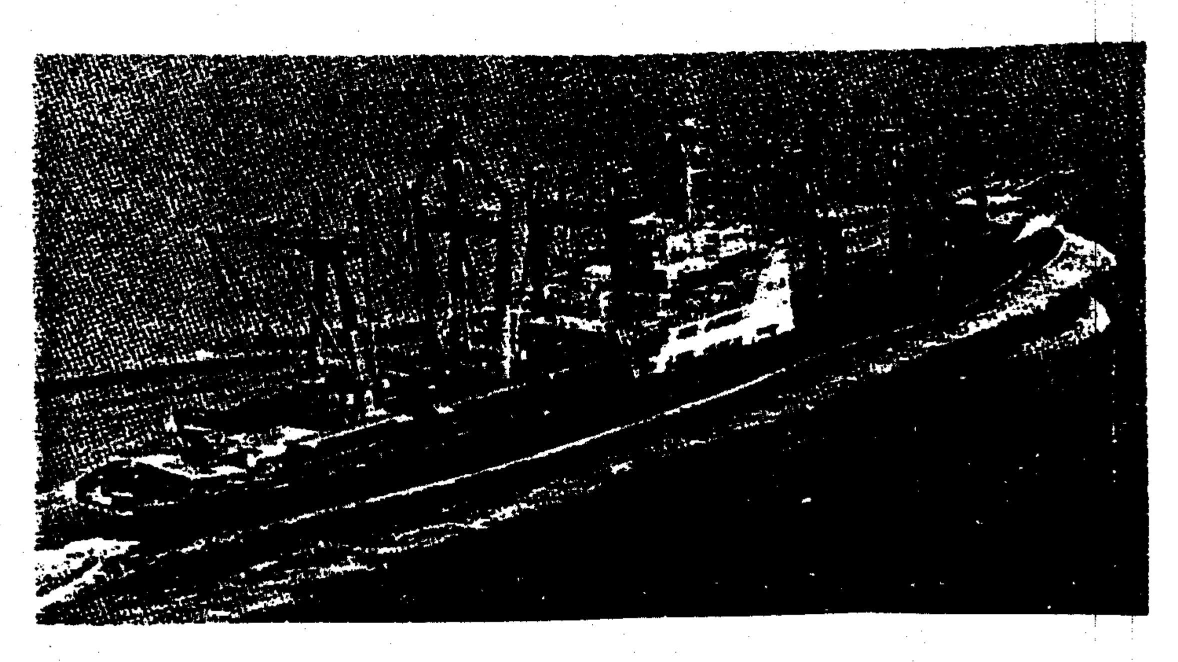
17.6 Breakbulk Vessels

Breakbulk vessels carry non-containerized general cargo. These ships provided all ocean movement of general cargo prior to the 1956 container revolution. As containerization proceeded, these ships were forced off major trade routes by more efficient containerships. Today, breakbulk vessels remain in operation on secondary and tertiary routes. Wherever containerization becomes feasible through modernization of port facilities, it spells the end of breakbulk shipping on that route, except for non-containerizable cargo.

On major trade routes, where containership operation is the rule, small shippers who would have been breakbulk customers in prior years, go through middlemen to have shipments consolidated and containerized for movement on containerships.

17.7 Specialized Vessels

Specialized vessels are tailored for certain functions such as transporting automobiles from factories to overseas markets. Specialized heavy-lift vessels are used to carry extremely large and heavy items. There are also customized ocean vessels for carrying livestock, and reefer containerships with pulg-in facilities for maintaining low temperatures in fruit, vegetable, and meat containers.



This ship is designed to carry outsized, breakbulk, liquid and dry bulk cargo, as well as containerized cargo.

17.8 Combination Vessels

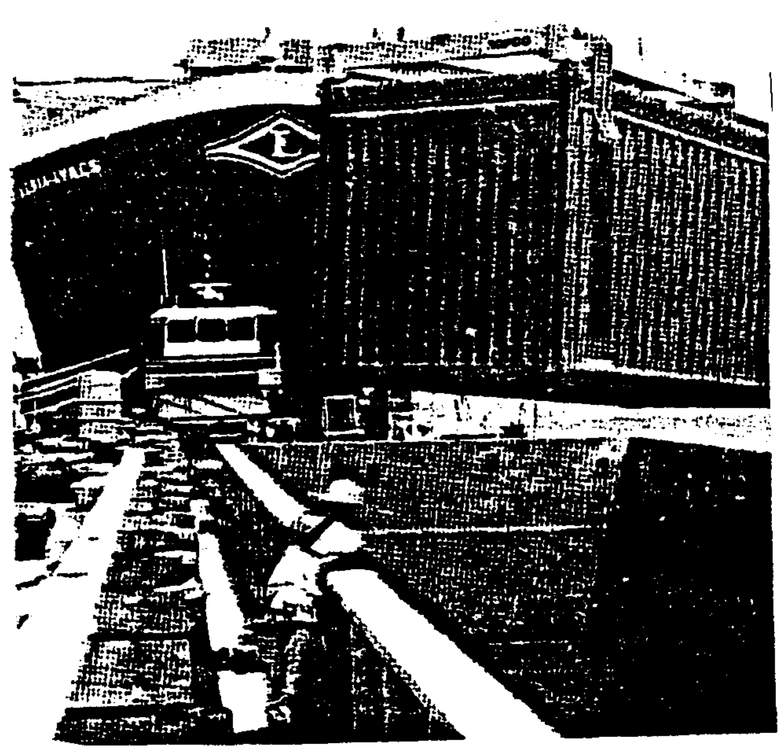
Combination vessels are of numerous types and configurations, including ro-ro/lo-lo; there-wya combination ships for containers, ro-ro and breakbulk cargo; and LASH ships for carrying combination cargos.

An unusual type is the OBO (oil / bulk / ore) which carries bulk, oil, or liquid products, one way and general cargo of practically any type on the return.

In finding the specific hybrid solution to particular trading circumstances, cargo mix and operational flexibility must be examined in terms of price charged, operating and capital cost differences, and any resulting change in overall vessel productivity. With harmonization, the impact of any one single market must be kept in line with existing market shares.

17.9 Bulk Vessels

Bulk ocean vessels are constructed for transporting basic commodities like petroleum, coal, grain, bauxite, and iron ore, or primary products like wood, paper pulp, rubber, copra, meat, vegetables, wool, and cotton.



Crane lifts a container on to a barge operating between New Orlean and Memphis, St. Louis and Chicago.

In a few, but growing number of instances, bulk commodities are being containerized for carriage in containerships.

17.10 INTERMODAL MOVEMNTS BY INLAND AND COASTAL WATERWAYS

There are about 25,000 miles of navigable inland waterways in the United States. The system is used mostly for moving bulk commodities. In 1986, nearly 1,037 million tons of bulk cargo was transported. Petroleum and petroleum products represented 46 percent; coal 19 percent; and the remainder mainly logs and lumber, grains, chemicals iron, and steel.

Most intermodal transfer facilities at barge terminals are devoted to the movement of bulk commodities, not general cargo.

17.11 Containers on Barges

Not to be overlooked is the carriage of intermodal containers on barges operating on inland and coastal system. These intermodal containers are used for bulk and general cargo. Containers are used for moving bulk commodities but the practice is somewhat unusual. New ways of utilizing existing channels are constantly being tested.

17.12 Intermodal Movements of International Cargo on Domestic Waterways

Barges operating on inland or intracoastal waterways carry domestic or international cargo's. Barges carrying international cargo transfer goods at gateway seaports in a variety of ways. Transfer facilities are extensive and varied, consisting of bulk and container storage and transfer units. Additionally, the barge itself may be carried on an ocean-going LASH vessel.

17.13 Barge vs. Rail Competition

The outstanding problem faced by bargelines is rail competition. Bargelines accuse railroads of adjusting rates unfairly so as to give shippers incentive to avoid waterway transportation and to move goods entirely by rail. For many years it has appeared that this problem is endemic o the competitive situation, and cannot be excepted to go away. However, deregulation has brought forth a new point of view regarding the future course of this and other competitive battles that reach such a high political pitch.

As more intermodal corporate consolidations take place, such as the acquisition of American Commercial Barge Lines by CSX, there will be a melding of opposing positions and the issue will fade away.

17.14. Coastal Services

Coastal water services operate between many larger ports on all three coasts of the United States, as well as the rest of the world's coastal nations. Most intermodal services are in competition against rail and truck. In some cases they are the only service available because of geographic, topographic and political obstacles. The slower water service can complete against rail or truck haul through lower prices.

17.15. Connecting Barge and Ocean Vessel Service

Larger ocean containerships are coming into operation in order to reduce costs through " economies of scale ". It is economically necessary that such large ocean-going vessels make fewer port calls. This brings into play connecting barge services between ports.

For example, Boston suffered a decline in ocean containership calls in the late 1970s an early 1980s, however, its coastal barge services were thriving.

Ship calls previously made at Boston had been discontinued, and instead were being made at other ports such as New York. The freight had to be moved to and from other ports such as New York in order to connect with transocean vessels. A considerable amount of freight to and from New England by passed Boston entirely, via truck and rail, but a certain amount used Bosto's port, moving in and out on coastal connecting barges.

The Boston example is more or less typical of a scenario occurring in many other places. As long-haul vehicles -ships, trains, trucks, or airplanes-get larger, there is strong economic compulsion to reduce the number of stops they make. When the number of stops made by the long-haul vehicle is reduced, freight at the bypassed location has to be brought to and from the vehicle, rather than the vehicle being brought to the freight. freight is brought to and from long-haul vehicles via connecting services, both single modal and international, and in that way a hub-and -spoke system is initiated. This is a standard scenario, occurring as the worldwide intermodal transportation system develops.

CHAPTER 18

"BRIDGE" SERVICES

Originally, the term's landbridge, minibridge, and microbridge were used to desrcibe the land portion of certain intermodal movements of fright between seaports on U.S. coasts, or from inland points and seaports. Today, landbridge also applies to oceanland (and, in some cases, all-land) intermodal freight movements in other parts of the world. Two examples are the Siberian and Mexican landbridges. The terms are descriptive, but competitive reprecussions go beyond the mere descriptive aspects, especially where encouraged by deregulation in the United States. (See Appendix B for a comprehensive listing of landbridge and minibridge services around the world.)

18.1 U.S. and Canadian Landbridge

First conceived in the early 1960s as a more efficient means of shipping between the Far East and Europe, the U.S./ Canadian landbridge uses transatlantic and transpacific water transport combined with rail piggyback to move goods across the North American continent. Two distinguishing characteristics of this landbridge are:

(1) The entire movement between Europe and the Far East is covered by a single bill of lading issued by a steamship company or NVOCC; and

(2) The goods remain in the same container for the entire movement. In spite of publicity given the landbridge, the volumes being moved are not significant. The U.S. / Canadian landbridge was intended to compete against the all-water route via India at a time when the Suez Canal was closed and the Siberian landbridge was not yet in full operation. Today, it competes with the all-water route via the Panama Canal.

18.2 Landbridge Services in the United States.

Of all landbridge services offered, perhaps none are as impressive or extensive as those provided in the United States. The growth of this form of intermidalism has been one of the most important in the 1980s. In 1981, only American President Lines, with its liner trains, and Sea-Land enough

volume to operate their own trains. The number of dedicated trains operated in 1981 probably did not exceed five a week. According to the U.S. Departement of Commerce this amounted to about 1.5 million long tons (2,240 pounds), or approximately 500,000 TEUs annually.

By January 1988, there were 76 dedicated train departures. Because neither railroads or steamship operators are required to provide this information, no published figures exist. However, given current load factors and operational load capacities, at least 2.8 million TEUs carrying a minimum of 30 million long tons were moved in 1988. During the mid-1980s the amount of cargo moving via landbridge increased by as much as 15 percent per year.

It has been estimated that as much as 50 percent of tonnage moving between the Far East and the North American East Coast travels on double-stack trains rather than the all-water route. Originally, landbridge was offered as a premium service. Landbridge between Asia Northeastern United States is 6 days to 2 weeks faster than all-water delivery.

Table 9 - Cost Analysis: Australia to U.S. East Coast

(West Coast Intermodal vs. East Coast All-Water)

(Expressed in cost per 20-foot container equivalent unit or TEU)

Table 9—Cost Analysis: Australia to U.S. East Coast
(West Coast Intermodal vs. East Coast All-Water)
(Expressed in cost per 20-foot container equivalent unit or TEU)

	Northbound Reefer		*Northbound General.*		*Southbound General*	
	Inter-modal	*All-Water*	*Inter-modal*	*All-Water*	*Inter-modal*	*All-Water*
Revenue	$5,034	$5,034	$1,562	$1,562	$2,156	$2,156
Variable costs	2,940	1,933	836	936	1,324	942
Equipment costs	716	872	261	315	261	315
Port and / or canal costs	55	164	55	164	55	164
Bunker costs	162	265	162	265	162	265
Total costs	3,873	3,234	1,314	1,680	1,802	1,686
Contribution to vessel overhead*	1,161	1,800	248	−118	354	470
Dolly contribution to vessel overhead**	51.60	46.15	11.02	−3.03	15.73	12.05

*Revenue minus costs.
**Based on 22.5 days per voyage for landbridge and 39.0 days per voyage for all-water.
Source: ANZDL. From Doug Pinkerton / Journal of Commerce, June 13, 1988.

* Revenue minus costs.

** Based on 22.5 days per voyage for landbridge and 39.0 days per voyage for all-water.

Source: ANZDL. From Doug Pinkerton / Journal of Commerce, June 13, 1988.

Despite faster transit times and, in some cases, higher quality of landbridge service, it has been suggested that for higher valued cargo, landbridge might even be more economical.For example, Australia -New Zealand Direct Line's 1984 decision to enter the North American-Australia / New Zealand transportation market was based mainly on the fact that landbridge was the most economical route.

The company estimated that two-thirds of its potential market were in the U.S. Midwest, Gulf and Eastern parts. Options taken into account included providing all-water services through the Panama Canal, or to call only at U.S. West Coast ports and rail the cargo overland.

More specifically, Direct Line's decision was based on the following. With an all-water route, the company would require 5.2 ships sailing on a 78 - day, round - trip rotation to provide service every other week from Australia.

The same service provided to the West Coast with rail delivery would only require three vessels with a 45 - day round - trip rotation. Landbridge had a higher unit cost when compared to all-water, until overhead and vessel productivity were factored in (see Table 9). Intermodal service marketing advantages existed in terms of valueadded services, such as electronic notification of cargo, etc. While cost comparisons with revenue levels are the same. Landbridge service also provided an extra 2 days at West Coast ports before final destination was selected. Because a high percent of the cargo was agricultural products (wool, meat and dairy products), this gave shippers additional time to broker the cargo. Finally, because Australia-New Zealand Direct Line was able to charter space with other double-stack vessel operators, no additional capital was required.

Landbridge Services in Canada.

Canada has a well-developed system for transporting containers. Most movements in Canada take place in the East between the Halifax and the Southern Ontario industrialized belt, or between the port of Montreal and the U.S. Midwest.

Despite extensive and long-standing use of domestic containers, the Canadian railways (Canadian National and Canadian Pacific) have been very reluctant to adopt double-stack container technology. Reasons for this are attributed to Canada's lack of high-density traffic flows into the U.S. and to the freight itself, which is much denser (with a higher percentage of

20-foot containers) and often exceeds weight limits of double-stack railcars. Clearances are often restricted on older routes. Some Canadian ports have limited space at their terminals, a situation that often conflicts with space-hungry single-level container cars and operations. Finally, railways are reluctant to make obsolete existing, serviceable equipment.

Only recently Canadian National purchased double-stack cars. Canadian Pacific will shortly complete a line improvement program in the Canadian Rockies.

This project will reduce curvature, eliminate tunnels, add a second track, lower grades and permit the use of two 9-foot 6-inch high containers through Rogers Pass in Southwestern British Columbia. These improvements will cost nearly $ 500 million (U.S.) dollars.

Improvements to the port of Vancouver, Britih Columbia (including labor concessions), coupled with these railway developments, will permit significant rail-bridge movements to take place in Western Canada.

Another factor weighing heavily in the expansion of Canadian Bridge traffic is the recent agreement between Canada and the United States to reduce or eliminate trade barriers. This however, is a process that needs further analysis and actual experience before its full potential is realized.

18.3. U.S. and Canadian Minibridge

U.S. minbridge was created shortly after land bridge. It applies to shipments moving between foreign and U.S. points. The rate is calculated as if throughall-water transportation were used to or from a port near the U.S. city of origin or destination. A shipment from Japan to Wilkes Barre, Pennsylvania, could use the all-water rate from Japan to Philadelphia, then a rail or truck rate from Philadelphia to Wilkes Barre, even though the cargo actually arived by sea at Los Angeles and moved by rail to Wilkes Barre via Philadelphia.

As in the case of landbridge, minibridge shipments are covered by a single bill of loading, and the goods remain in the same container for the entire movement. Minibridge tariffs are published by steamship lines, and the proportional ivisions of revenues are negotiated by steamship lines with other intermodal carriers.

Minibridge systems link the Far East with U.S. points via West Coast and East Coast ports (as in the Japan-Wilkes Barre example), and link the Far East with U.S. points via West Coast andGulf ports.

An example of the latter is a shipment from Montgomery, Alabama, moving by rail to New Orleans, then to the port of Los Angeles, and by ocean carrier to, Korea.

There also are systems linking Europe with U.S. points via East Coast and West Coast ports (for example,Hamburg, Germany, via New York and San Francisco to Sacramento), and also systems linking Europe with U.S. points via East and Gulf Coast ports (Dallas to Copenhagen via Houston and Baltimore).

18.4 U.S. and Canadian Microbridge

Microbridge service and rates were devised in 1970 to apply directly between interior U.S. and Canadian cities and foreign cities via a single port, avoiding double port rates and transits involved in minibridge systems. Modifying the minibridge Japan to Wilkes Barre example, the microbridge movement would be from Japan to a West Coast port such as Oakland, and then direct via rail piggyback to Wilkes Barre, avoiding the port of Philadelphia.

The movement would be aharged a through rate, possibly discounted below the combination of rates via the port used. A microbridge shipment also is covered by a single bill of lading issued by asteamship company or NVOCC. The goods remain in the same container for the entire movement, and tariffs are published by steamship lines, which negotiate proportional divisions of revenues with their intermodal partners.

Neither shippers nor consigness have a say in determining routings or port gateways to be used in microbridge movements.

18.5 U.S. and Canadian Airbridge

Not technically fitting the definition of landbridge, but practically the same theory of intermodal service, is the movement of sea-air traffic between the Far East and Europe via the United States and / or Canada. Ocean carrier service is used across the Pacific, and air between the U.S. / Canadian West Coast and Europe. Most traffic moves eastbound from the Orient to Europe, with relatively small amounts moving westbound.

The objectives of landbridge and airbridge are generally the same: to combine low rates with reasonably fast and reliable service. The services, however, differ. Landbridge traffic moves forward in the same container in which it started, but sea-air cargo usually is taken out of the sea container at

the West Coast seaport, trucked to the airport and then placed in an air container.

18.6 Competitive Stir and Turmoil

Minibridge and microbridge rates and services, especially those of microbridge, caused considerable competitive stir and turmoil. Deregulatory moves by the ICC and the FMC have given aggressive carriers greater freedom to use these systems to undercut existing rate structures, to divert cargo from ocean shipping conferences, to negotiate rates with shippers, and to implement through rates without notice or explanation of the proportional division of revenues among participating intermodal carriers. As much as 40 percent of intermodal teffic is marine bridge traffic; as much as 50 percent of ocean borne traffic from the Pacific Rim reaches its final destination by rail intermodal bridge movements.

It 's a new ballgame for carrier executives who have woked by the 1916 Shipping Act rules that permit ocean carriers to join together to fix and enforce rates and conditions of service. One of the most significant deregulatory moves by the ICC was to eliminate piggyback rate regulations, permitting ocean carriers to establish through intermodal rates using piggyback almost any rate level they wished.

The ICC move was soon followed by FMC action permitting publication by ocean carriers of intermodal through rates without separating the amount representing the ocean portion. A substantial share of ocean traffic moves under point-to-point rates. The Shipping Act of 1984 allowed not only individual carriers but ocean rate-making conferences to publish point-to-point.

18.7 Bridge Benefits to Shippers

Shippers are generally happy with rates and services they obtain with bridge systems that continue to develop and expand in the wake of deregulation. In the past, U.S. expporters had to make separate arrangements and prepare separate paperwork from inland origin to export gateway, then from export gateway to foreign port, and then again for inland transport from arrival port to final destination. They also had to contend with problems of cartage, local transfer, and warehousing. Only the most professional traffic managers of large companies with large staffs and overseas correspondents could obtain the best rates and services. Today's shippers can deal with a single

transport organization (whether carrier or middleman) and be relieved of this multitude of worries.

18.8 Truck Transfer of U.S. Bridge Traffic at Gateway Ports

While intermodal enthusiasts talk about through movement of containers from ocean vessel to rail piggyback and vice versa, close inspection of actual port activities reveals that transfer of containers seldom is direct between ship and rail. Usually an intermediate truck haul (or movement of containers by port handling equipment) is involved. (In some instances, the cargo itself is transloaded from ocean containers to rail piggyback containers and vice versa at gateway ports, rather than moved in intermodal containers through the port.) There are three reasons why an intermediate truck or other vehicle haul frequently is involved in the transfer of containers between ocean vessel and rail flatcar --

1. Transfer to and from mobile vehicles usually is more efficient and convenient than transferring directly between ship and rail train because of the awkwardness and expense of positioning each flatcar in sequence alongside a ship.
2. Railyards and rail facilities often are some distance from the it would be expensiveand difficult to extend them into the port area, which already may be congested.

It is desirable in many instances to truck intermodal containerized shipments between ports for consolidation purposes to mesh with an ocean vessel schedule and / or a unit train buildup.

Sometimes the goods themselves are transferred between ocean vessel and railroad without the use of containers because some ocean carriers are experiencing difficulty retrieving containers that have moved inland on minibridge or microbridge services. This is an interesting parallel to sea-air transportation, wher cargo moves from one container to another at the airport. Airlines had problems when their containers moved too far from the airports.

At one time, some containership operators in Los Angeles offered "transloading allowances" of \$ 150 to \$ 200 per 40-foot container as an incentive to customers to transfer freight to rail containers from ocean containers for the inland portion of the through movement. This contradicts the theory of using a single container for through movement of intermodal shipments.

If transloading allowances become a significant part of bridge movements, then the definition of intermodality must be modified to say the goods remain in the same container for the entire movement.

Nevertheless, economics is the driving force behind all these services, and a change in underlying economic factors inevitably results in changes to the end product.

Ocean carriers prefer to unload import cargo at the first port of call to minimize transit time and maximize backhaul capacity. Carriers thus call first where the most important cargo (local *and* intermodal) can be unloaded; the opposite is true for exports, in which the ocean carrier seeks to load the most cargo at the last port of call.

First and last ports of call tend to attract shippers seeking faster transit. The advantage of using the first port of call outweighs any small differences in rail transit time for intermodal imports. Conversely, the last port of call gives the fastest posible transit time for exports, since they are not delayed while the vessel calls at other ports.

18.9. Los Angeles / Long Beach Ports

Changes taking place at the combined ports of Los Angeles / Long Beach illustrate how these procedures affect the ports themselves and the carriers operating there. Anticipating a continuing increase in minibridge and mocrobridge traffic, the two ports have joined together to develop a plan (Project 2020) to meet the needs of marine traffic expected to move through Southern California by the year 2020.

Since the two ports are quickly running out of land for harbor expansion, the only feasible solution will be to construct new landfill projects in San Pedro Bay. This will involve 2,500 new acres divided between the two parts. Seven miles of deep draft channels, with as much as 76-foot depth, will be available, along with an extensive and modern system of highway and rail connections and intermodal container transfer facilities. On-dock or near-dock container transfer, in particular, will give the ports an advantage over other ports that have no or limited intermodal services of this kind.

Projected total coast to fully implement Project 2020 is about $ 4.8 billion.

A key intermodal element will be the container handling and transfer facilities on and off the marine terminals.

Discussions are presently underway with major railroads now serving the ports to lease or acquire direct or unimpeded access to these facilities, and to allow for rail on-dock container transfer operations to take place, thus reducing the need to transfer containers in the more traditional highway system, which is already at or near capacity.

18.10 Three Railroads Serving.

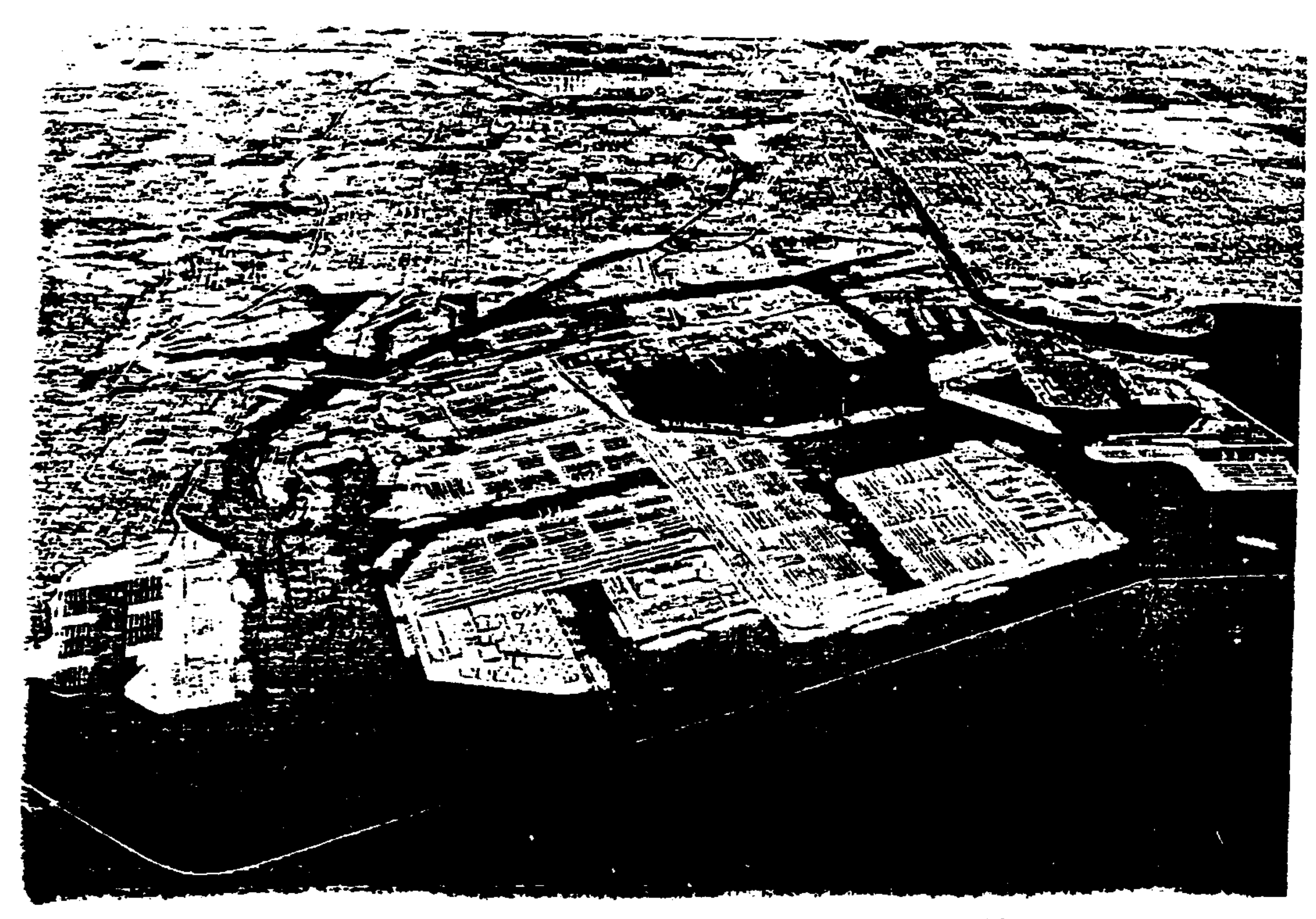
The Southern Pacific, Santa Fe, and Union Pacific Railroads serve the Los Angles / Long Beach area. Currently, intermodal containers are trucked between the ports and downtown railyards of the three railroads-a distance of 22 to 25 miles taking 1.5 to 2.5 hours. Containers moving between the ports and their intermodal container facility experience only a very short 4-mile truck haul. The removal of railroad trailers from freeways eases congestion, and benefits the railroads. However, truck transfer of sea-land intermodal containers, to some extent, still is required by all three railroads.

Container-Truck Operations fill a Need. To satisfy truck connecting requirements between sea and rail at U.S. West Coast ports, container-trucker operators have come into existence. These companies operate a number of container yards (CY) to facilitate transfer of units.

They also maintain a number of container freight stations (CFS) where freight is loaded into or unload from containers, or transloaded from container to container. CFS facilities are similar in function to container stations near major airports.

It is possible that the sea-rail trucking aspect of container-trucker companies will diminish in the future depending on: (1) Project 2020; (2) the likelihood of ocean carriers or container leasing companies diversifying into the container trucking business; and (3) ocean carriers' growing reluctance to move containers to the U.S. interior largely because of high repositioning costs. Although activities may diminish in future years, the same factors my give them an opportunity to expand their CFS activities, especially if they position themselves with rail, truck or sea carriers with service provisions. Change of direction is a difficult maneuver, but readiness and flexibility are essential assets in a free economic environment.

This is exactly what California Cartage did in April 985. It shut down it trucking operation, on non-competitiveness as a union trucker with high labor expenses. The company announced that it would continue its warehousing, foreign trade zone, and container station activities.



Rendering of one of two schemes for Project 2020.

18.11 Baltimore's Bid as an Intermodal Gateway

Developing an all-purpose marine intermodal terminal is both time consuming and of considerable risk. Nevertheless, Baltimore is in the final stages of completing a $ 250 million, all-purpose intermodal facility on the U.S. East Coast. Once it is in full operation in 1989, it will have the most modern container handling equipment (much of which will be fully or semi-automated) and communications system, (allowing for faster movement of containers between ocean, rail and highway). Although the port is of a considerable distance from the open sea, forcing vessel carriers to take the "Chesapeake Cruise "its relatively closer position to the U.S. heartland and good rail service, would make the port a powerful contender in the race for being one of the major ports on the East Coast.

18.12 Changed Competitive Relationships

The growth of bridge services has brought great change in competitive relationships between regions, among various ports and within the steamship industry. With the rise of Pacific Rim nations as economic

powers, bridges have greatly aided Pacific Coast ports, while producing less than desirable results for East and Gulf Coast ports. These latter ports depended on the Far East for a third of their foreign trade. At least one port reported a 50 percent drop in tonnage between 1985 and 1987.

Bridge traffic has had a vast range of impact on the individual Pacific Coast ports. In Seattle. only about a quarter of the imports entering the port in 1987 were consumed in the immediate hinterland while larger portions continued on to interior and East Coast points by double-stack railcars.

The big winners are the twin ports of Los Angeles and Long Beach, which despite the large Los Angeles Basin population, moves as much as 50 percent of their cargo to inland points, up from 36.5 percent in 1981. San Francisco and Oakland, although showing increased tonnage, have lost relative market share because of railroad tunnel clearances on the maximum height limitation for double-stack containers.

Nevertheless, 40 percent of Pacific Rim imports move on the East and Gulf Coasts.

A large part of the failure of Malcolm McLean's U.S. Lines round-the-world application was due to faster and somewhat mor cost-effective bridge service competition. Equally significant was the steady drop in traffic carried by major Japanese lines serving the East Coast by way of the Panama Canal. This forced these lines to enter into pace charting arrangements with each other to maintain service and, in some cases, presence in the trade.

Still other lines that resisted intermodal bridge transportation have performed, on the whole, more poorly than those who have taken some form of active role in providing bridge transportation.

Reasons for Landbridge Popularity. Landbridge has emerged as a major force in intermodal freight transportation for several reasons:

(1) U.S. deregulation of inland transportation;

(2) The growing importance and understanding of logistics management;

(3) The breakup of ocean rate-making conferences along with the emergence of point-to-point pricing;

(4) The development of new transportation and communication technologies.

In the 1980s, the rising value of inventory and escalating interest rates spurred adoption of logistical control.

When properly implemented this lowers total distribution costs, even if one component, such as transportation cost is raised in the process. Control of cargo movement from manufacturer to consumer, coupled with deregulation, led to the emergence of point-to-point rate quotes. Finally, with more flexible and faster speed of information, together with double-stack container rail technology, intermodal transportation has a real chance to prove itself.

18.13 Detractors of Bridge Systems

Detractors of the bridge system comprise three categories: ocean carrier executives, port executives, and shippers. Some ocean carrier executives believe that unbridled competition will force many ocean carriers out of business, destroying the conference system, the ocean shipping business, and especially U.S.-flag carriers. Some port executives are worried that their ports will be bypassed. Some shippers are worried about their ability to cope with the thousands of new point-to-point rates. They also suspect that large shippers will benefit from their ability to negotiate preferentail rates.

Many transportation experts believe that minibridge and microbridge users will siphon away high-value cargo, leaving direct ocean carriers with only-value, port-to-port cargo, on which they will be forced to raise rates in order to remain solvent.

Other detractors of bridge systems point to the continual shift in the direction cargo moves that often unbalances full and empty containers. For example, recent forecasts see exports from Europe to the United States growing by just 4 to 4.5 percent over the next 4 years, with container trade rising by 6 percent a year. Trade in the other direction is expected to increase 8 to 8.5 percent in the 1989, with an equal or slightly less increase during the next few years.

These shifts will cut westbound load factors from the 90 to 95 percent enjoyed over the past few years to 80 to 85 percent in 1988 - 89, while eastbound load factors should stabilize at around 55 percent. The gross imbalance between supply and demand seems certain to bring box rates under pressure unless there is much greater amalgamation of services.

18.14 FOREIGN LANDBRIDGES

There is a very competitive atmosphere among various landbridge alternatives across Canada, the United States, and Mexico, as well as via the all-water Panama Canal route.

18.15 Mexican Landbridge

The Mexican landbridge spans across the Isthmus of Tehuantepec (a land distance od 182 miles) between the Pacific port of Salina Cruz and the Gulf of Mexico port of Coatzacoalcos. Both rail and highway provide Service carriers. Transit time across the isthmus is 6 hours by highway and 12 hours by rail. Service started in 1982, but the impact on competing ports and services has not yet been felt.

Officials of the Servicio Multmodal Transistimico (Semultra), the landbridge organization, hope to attract business from the Panama Canal and North American bridge services. Under normal circumstances the Mexican landbridge should cut about 12 hours off the canal route.

Mexican officials expected to move 50,000 containers in their first full year of operation and 150,000 the second, with increases to 500,000 in the year 2000-or 10 percent of the combined movement of canal bridge services.

Although the Mexican government invested much money in adequate handling and haulage facilities at both ports and in the railway for container operation, results to date have been very disappointing. The terminal ports of the Mexican landbridge do not have a substantial hinterland, thus increasing the risk of investment.

The South Atlantic Gulf and Mexico Service of Harrison Line, CGM, and Hapag-Lloyd from Northern Europe operated for a while on a weekly basis at Coatzacoalcos but eventually discountinued the operation because of insufficient traffic. Japanese ships called at Salina Cruz, but they operated a breakbulk, not containerized, service.

In 1983, the national steamship line of Mexico moved large volumes of containerized chemicals from a factory near Coatzacoalcos intermodally via rail to Salina cruz and then via ocean vessel to overseas destinations, mostly in the Far East.

However, this traffic was not under the control of Semultra because it was not technically landbridge taffic, not having arrived at Coatzacoalcos via ship.

18.16 Bridge Traffic and Its Affect on the Panama Canal

One of the largest losers of the diversion of container cargo to bridge traffic is the Panama Canal. Since its completion in 1914 the canal has been the main artery between the Atlantic and Pacific oceans for trade. Containerships used it to move cargo between major ports, much of which, because of its high value ratio to volume, helped pay the cost of operating the canal.

With the startup of bridge activity on the West Coast, many carriers abandoned the canal, some of them in a very decisive way by constructing their new vessels larger and wider than the canal's dimensions allowed -so called post-Panamax ships - with a beam width greater than 105 feet (locks in the canal are 110 feet wide).

Container volume through the canal has grown about 7 to 8 percent annually over the past several years and, in 1987, stood at 1.3 million containers. (The Panama Canal Commission, which operates the canal, does not measure container volume in TEUs as is commoly done). Containers now account for about 14 percent of the 150 million long tons moving trough the canal each year. Containerships and car carriers generate about one-third of the canal's toll revenues.

With increased efficiencies and economies that are becoming associated with bridge traffic, the canal is in a less certain position than what may have been the case only a few short years ago.

18.17 Central and South American Landbridgesý

Panama offers a bridge service from Pacific Coast ports to the Atlantic side, using the Panama Railroad. This is part of the Panamanian government's centerport concept for shipment and storage of foreign goods. Actual progresss and information on TEUs handled, however, are not available.

The governments of Argentina and Chile have experimented with movement of agricultural products by rail across the Andes. It has been reported that a shipment of soybean went by rail from Argentina to the port of Antofagasta, Chile for transhipment to Mexico.

18.18 Siberian Landbridge

The Siberian landbridge provides overland intermodal service between the Pacific Rim and Europe. (Japan to Western Europe accounts for 80 percent of the traffic carried.) It has been in operation since 1967-as long as the North American landbridge. Conditions of service on the Siberian route have not been as good as those on the North American route from the beginning, but new improvements planned for facilities and transit times will make this bridge very competitive with all-water routing.

The Siberian landbridg consists of a complex system of land and marine transportation. It involves three steamship lines that operate between Japan and Siberia. Two of them are Japanese (the Yamashita-Shinnihon Steamship Company and the Iino Kaiun Lines) and one is Soviet (the Far Eastern Shipping Company). The Siberian containerports served are Nakhodka and Vostochnyy, the latter is the primary transhipment point. Containers are hauled overland by the Trans-Siberian Container Service of the Trans-Siberian Railroad. This service is operated by Soyuztransit.

At the western end of the landbridge, cargo must be transferred again instead of continuing by rail onto Western Europe because of the wider gauge used on the Soviet railway system. There are a number of transfer points. The largest volumes move through Brest on the Polish border, where transfer is made to either European standard guage rail, or highway. Approximately 60 percent of the TEUs make the final leg of the journey by truck. Riga is the transhipment point for the Baltic. A new service, named Finanglia Ferries (a joint venture of United Balti Corp. Of Britain and Finncarriers) takes advantage of the common rail gauge of Russia and Finland to provide rail/water service from Kotka, Finland, to Western Europe and the United Kingdom.

Rail connectors are provided at Chop on the Czechoslovakian border, Djulfa on the Iranian border, Termez on the Afghanistan border and Ungenyon the Romonian border. Service to Western Europe is jointly offered with Intercontainer through Hungary, using Austria as an interchange point.

Service Improvements. The Soviets have worked very hard at improving their ports, particularly Vostochnyy on the Pacific, which had been a source of great delay. Currently, containers can be transloaded there in 24 hours or less. Transloading operations on the Baltic have been consolidated at the recently modernized port of Riga, rather than Leningrad, which had been subject o delays as long as three days.

Completion of the Baikal-Amur Mainline (BAM) rail route, which parallels the older Trans-Siberian Railway to the north, has provided added rail capacity. BAM is a four-track mainline, compared to the two-track Trans-Siberian. Thus, cargo is not delayed by higher priority passenger on military trains.

Operating container flatcars in block train movement has contributed to speedier, more consistent transit times. The increase in container car size from 14 meters to 19 meters has added capacity. Finally, development of container tracking systems has reduced delays and problems from "missing" containers.

Current and Future Capabilities. Currently, transit times from Japan to Western Europe are 30 to 35 days. Formerly, overland service took up to 6 weeks; the all-water route took 29 days.

At the present time, Sotra transports 94,000 containers annually, with tonnage reaching as high as 1.3 million tons. This is down considerably from the 117,000 containers handled in 1981. The decline is attributed to the loss of large amounts of freight that went to both Iran and Afghanistan, two important branches of the rout, before fighting broke out in those countries.

The USSR and the People's Republic of China are reportably working on a new line across Soviet Kazakhstan, because of vastly increased trade between the two countries. If the 4,000-mile rail link is completed, transit times between Hong Kong and Europe could be reduced by as much as a week.

If average train speeds increased from 45 kms per hour to 60, transit times from Japan to most Western European cities could be reduced to 25 days.

Rates on cargo moving via the Trans-Sibberian landbridge are 10 to 30 percent below ocean conference rates. If the Soviets implement double stacking with improved transit times, they might handle 600,000 TEUs a year, an increase of 600 percent.

Another factor that should be considered is the potential results of *perestroika*, a movement that could open new opportunities for USSR landbridge systems based on modern and more competitive incentives.

18.19 Siberian Airbridge

For several years Jeuro Container Transport (U.K.) has offered land-air-sea container service linking the United Kingdom with Japan via Siberia.

There are two interesting aspects of this service. First, this intermodal air-surface operation is similar to, and in competition against, a similar air-surface operation between the same countries via the united States and Canada. Second, it employs heavy marine intermodal containers in air transportation, similar to use by Seaboard World Airlines in the 1970s, but later abandoned by Seaboard when a sufficient number of lighter-weight air intermodal containers became available.

In the Jeuro service, 20-foot marine containers are hauled by road (including a ferry crossing of the English Channel) from the United Kingdom to Luxembourg. From there they are airlifted by Aeroflot IL-78s to Vladivostock, and them moved by one of three steamship lines to Yokohama, Kobe, or Nagoya.

Door-to-door transit times of 15 days are guaranteed, with rate reductions offered for every day of delay.

18.20 Chunnel and European Railways

By 1993 the Anglo-French Channel Tunnel (Chunnel), will connect Dover and Calais via 31-mile tunnel, 24 miles of which are under the English Channel. Cost of construction will be $ 8.8 billion. Under the current plan, shuttle trains, many of which would be dedicated to intermodal operations, would depart from two terminals every 20 minutes, stepped up to every 10 minutes at times of high demand. Tunnel transits of 30 minutes, with shuttles traveling at 87 mph, would offer 1 hour and 15 minute service between British highways and roadway networks in France. This would save upwards of several hours from the more traditional highway-ferry-highway system using basically the same route.

Further stimulating the increased use of the Chunnel is the removal of regulatory barriers within the European Common Market in 1992. This will place additional pressures on ferry companies and port operators, many of whom have spent years improving speed and booking and check-in-facilities.

18.21. Ports Emphasizing Distribution Role

Changing world trade patterns, emerging transportation technology and stiffer competition have caused the port industry to rethink their primary role in transportation. One such port is Rotterdam, which handles about 250 million tons of cargo (mostly bulk) a year. Although its hold on being one of the world's largest cargo handling ports is not likely to be challenged in the

next decade, it is just the same, concentrating efforts on consolidating its positions as Europe's premier distribution center.

The main thrust of Rotterdam's strategy is to eliminate any remaining bottlenecks and improve rail and road connections in preparation of the European Common Market in 1992. At the same time Rotterdam is positioning itself to be one of Europe's most efficient electronic ports by installing over 50 miles of fiber optic cables. This will allow customers using the port to communicate faster and with a larger amount of real-time information, leading to what some consider to be a paperless port.

Other Pressures on Ports. The race to become a fully integrated marine intermodal facility has forced some ports to deal with pressures that did not exist several decades ago. With greater urban population densities and changing lifestyles, port administrators now must consider other potential users of waterfront properties, including commercial, residential and recreational activities, some of which are not compatible with the more intensive marine cargo industry.

Some ports, like San Diego, made the decision just after the dawn of containerization that they would not be able to compete successfully with ports within the same geographic proximity. Other ports, like Seattle and New Orleans have lost some of their prime waterfront areas to non-maritime related activities, but still remain competitive at other locations in the port area. These issues and the recognition that environmental considerations weigh heavily on future upgrading and expansion plans, signal a change in what was once considered a traditional waterfront activity.

Smaller Ports as Intermodal Gateways. Although size and volume are still comparatively less, smaller ports have adopted intermodal strategies. Taking advantage of good rail inland highway access service, for example, the port of Milwaukee planes tore-establish its once active marine terminal facilities in hopes of again becoming a major transportation center in the Great Lakes region.

Despite economic and possibly political obstacles, the port of Djibouti in French Somaliland hopes to do the same. Djibouti has little industry or agriculture of its own and, with 500,000 inhabitants, has a relatively small base of local cargo. However, it is strategically located at one of the world's most important transportation corners, and with the development of modern and efficient intermodal facilities it plans to become a major transshipment center in that part of the world.

Carriers Take Control of Cargo Routing. At the same time, ports are feelings another kind of pressure that leaves many of them unsure of the future-the degree of influence shipping lines have over port routing. Factors that go into the port routing decision include port productivity, integration of marine and rail facilities, cost incentives, bureaucratic interface, rail height clearances, cargo balance handled by fewer carriers bearing ever higher capital investment costs, speed of processing cargo is assuming greter importance. In a 1986 speech, Richard Hill, president of American President Lines' domestic division, noted, "As governments continue toward reduced spending on customs and agricultural inspection services, successful ports will be those that assume an expanded role to ensure that bureaucratic encumbrances do not interfere with expedited transits ".

18.22. DOUBLE-STACK TRAINS

The remarkable concept of placing two containers on a railway flatcar existed long before it was finally put into practice. The original equipment was designed by Southern Pacific Railroad in conjunction with ACF Industries in 1977.

The equipment was operated by Southern Pacific for Sea-Land in 1980, but no more equipment was order. The idea languished until 1984 when American President Lines (APL), working with Thrall Car Company, designed a new lightweight double-stack car and began extensive double-stack operations. The operation was copied by nearly all-major Pacific Ocean carriers and some railroads shortly thereafter.

The number of double-stack movements increased dramatically in the 1980s. In April 1984, only American President Companies (APC), the parent of Apl, offered service once a week between Los Angeles and Chicago. By December 1985, eight operators-APL, the Burlington Northern Railroad, MDL, Maersk, NYK, OOCL, Sea-Land and U.S. Lines-were provide services from both coasts.

The companies provided services at Atlanta, Chicago, Cincinnati, Columbus, Houston, Los Angeles, New Orleans, New York, Oakland, Savannah, Seattle/Tacoma and St. Louis. By 1985, there were 32 eastbound trains a week. As of June 1988, 76 trains operated each week between 20 city-pairs with Baltimore, Charleston, Dallas, Detroit, Jacksonville, Kansas City, Memphis, Portland and Welland (Canada) joining the list. On average, 1,446 TEUs were being carried weekly.

Carriers adding this service to their operations included Evergreen, Hanjin, Hyundi, "K" Line, Y-S Lines, and the CSX, Grand Trunk and Santa Ferailroads. U.S. Lines dropped out in early 1987.

Double stacking of intermodal containers is just one more competitive advance in a deregulated industry, where advances are occurring with increasing frequency and effect. The ripple effect on many other aspects of intermodality is significant and lasting.

18.23. Advantages of Double Stacking

The principle advantages of double stacking containers on trains are reduced train lrngths and reduced capital costs per payload ton carried. train length has little significance except on single-trackmainlines (common in Western United States), passing sidings limit train length and the number of containers that can be hauled on one train. Double-stack equipment double the number of containers per train, thus cutting train crew labor in half. (Labor is a major expense on U.S. railroads, amounting to as much as 60 percent of line-haul costs). The reduction in capital costs arises from the fact that containers, unlike trailers, have no expensive running gear or chassis that must be carried around.

Each double-stack car can carry the same payload for about 75 percent of the capital of a single-level platform, because the articulated design permits elimination of four sets of railroad wheel sets (trucks or bogies) and three pairs of couples and air hoses.

Other operational savings can be gained in fuel costs. A standard railroad flatcar has a tare weight of about 70,200 pounds, but the APL stack-train platform weighs about 32,200 pounds-a savings in tare weight of 38,000 pounds. Net payload to tare ratio is 0.67 for conventional type TOFC service versus 1.91 for double stack. This reduction in weight translates into a 41 percent savings in fuel costs.

Cost savings for the line-haul portion of the train movement have been estimated as high as 40 percent by the Association of American Railroads. Other estimates (Temple, Barker and Sloane, Inc.), however, indicate total cost savings of through movement when compared to conventional TOFC is about 20 to 25 percent. The lower figure reflects the higher drayage expense caused by the fact that doublestack terminals are fewer in number and farther between.

An important cost savings and marketing advantage for double-stack lies with low loss and damage claims. The platform articulation eliminates some couplers and associated gear.

This has reduced slack action, or the running in and out of couplers that magnifies the forces of inertia and creates damage to cargo. Double-stack operations are also rarely switched when loaded, thus further reducing rate of cargo damage. Hump yards (where bump into one another as they are classified and pushed over the hump) are, as a result, avoided.

Table 10-Typical Cost Structure of Competitors for General Freight

Mode	TOFC	TL by LTL Carrier	TL by Independent Contractor	TL by Irregular Route Carrier	Double-Stack Domestic Container
Trailer mile / year	625,000	80,000	100,000	140,000	1,040,000
Annual wage	$33,000	$27,000	$25,000	$28,000	$28,000
Wage plus fringe / year	$44,450	$33,750	$25,000	$32,200	$32,200
Labor cost / mile	$.07	$.42	$.25	$.23	$.03
Fuel cost / mile	$.10	$.18	$.26	$.18	$.09
Pickup & delivery	$.25	$.075	0	0	$.25
Equipment ownership	$.104	$.125	$.212	$.148	$.041
Direct cost / mile	$.525	$.798	$.752	$.544	$.414
Circuitry	1.15	1.10	1.00	1.00	1.15
Adjusted cost / mile	$.603	$.877	$.752	$.544	$.476
Load ratio	.65	.75	.85	.90	.90
Typical cost / loaded mile	$.920	$1.169	$.886	$.604	$.52
Cost / loaded mile (with .85 load ratio)	$.709	$1.03	$.886	$.640	$.56

Source: Courtesy of Paul O. Roberts Associates.

Double-stack cars, especially the bulkhead type, are also a deterrent to theft because the container doors cannot be opened while in transit. Since loss and damage is greatly reared by shippers, double stack's loss and damage experience is a significant marketing advantage.

18.24 Disadvantages of Double Stacking

Principal disadvantages of double stack are the large volumes of freight required to make it viable and high terminal costs. Double stacks have higher terminal costs than conventional TOFC. As a result, double-stack trains can only operate economically in long-haul service where high terminal costs can be spread over more miles, thus reducing terminal costs to total revenues. The requirement for high volume, long-haul lines limit the markets where double stack can operate successfully.

As time progresses, cost studies and new technology may shorten the breakeven distance for double stack. Given careful asset management and reasonably high volumes, it has been suggested that double stack can operate in corridors as short as 500 miles. Furthermore, double-stack trains need high overhead clearances (a minimum of 20 feet, 6 inches is required to accommodate two stacked 9 foot, 6-inch high containers). This rules out many potential routes where restrictive tunnel and bridge clearancea are

encountered. However, low line-haul costs (see Table 10) have made it economical to open many routes.

18.25 Ocean vs. Rail Carrier Competition

With many containership lines now operating their own rail services within the United States, some railroads are experiencing a sense of insecurity regarding their market share and control of business that moves over their lines. It is the same feeling of insecurity a direct carrier feels when a very high percentage of its business comes from one customer or through one middleman. It happens in all modes. Some carriers become " wholesalers, " but this makes them vulnerable to the whims of their single large customer, who can leave them to favor another carrier if he is not satisfied.

Other direct carriers adopt the " retail " approach in order to keep in touch with direct shippers, and to guide their own destiny. This, however, puts them in direct conflict with the single big customer, middleman, or in this case, containership line, which could take a lot of business from them.

Rates for double-stack liner train operation are negotiated by containership lines with railroads, and railroads are dependent on the rate of return from these operations. These are concern that the market will be flooded with double-stack linertrain capacity, because its economies are drawing many new operators. Over capacity may lead to further reduction in yield to railroads.

18.26. Ocean Containership Competitiveness

Double stacking only intensifies the already bitter rivalry that exists among ocean containerports. It adds to the concentration of activity at selected ports that was started by loadcentering. When a large containership operator decides to concentrate port calls at a single seaport, its subsequent decision to operate double-stack liner trains naturally would be centered at the same port-and that decision would be supported by the rail carrier operating there.

Among East Coast Ports. Tunnel and bridge clearances on rail access lines to a port have to be sufficient of the port is to be a double-stack rail terminal. In eastern United States, bridges and tunnels were built a long time ago and sufficient clearances exist in only a relatively few instances. Clearances on some lines into the port of New York appear to be okay. There is concern at other east Coast ports that double stacking will further divert ship calls from their ports to New York.

Among West Coast Ports. The spread of double-stack liner train operations in a short time period is due not only to carrier competition but to port competition. Traffic movement is mostly from the Orient via West Coast gateways. Los Angeles, Oakland, Seattle and Tacoma are vying to be doublestack liner-train loadcenters. In 1987 alone, the number of double-stack trains leaving West Coast ports grew from 40 each week in early 1987 to 62 a week by the end of the year.

Twenty-seven of those trains leave from the Pacific Northwest, 4 from the San Francisco Bay area and 37 from Southern California.

Between East Coast and West Coast Ports. With bridge and tunnel clearances more favorable in the West than in the East, West Coast ports possess a new competitive advantage for export and import traffic in the newly-arrived double-stack era.

18.27 Operations Problems with Double-Stack Trains

Rail carriers have mixed feelings about double-stack train operations. Negatives thoughts, however, are not being expressed too loudly in the face of the headlong rush to compete in double-stack markets. In additional to the need to improve bridge and tunnel clearances, there are questions about improvements needed in roadbeds, rolling stock, and terminal facilities. Terminal facilities require considerable improvement in many localities in terms of space and handling equipment. Double-stack containers operated in double-stack trains create problems in sorting out TOFC, COFC, and double-stack loading and unloading operations at terminals.

18.28 To Double Stack or Not to Double Stack?

Intense competition between carriers has placed many in a dilemma. Japan Lines, an important but not necessarily large carrier on the North Pacific route, compared to APL, Sea-Land or Evergreen, has tried to inaugurate a small, double-stack operation out of Los Angeles and Seattle, using Southern Pacific and Burlington Northern respectively to Chicago.

Until volume begins to pick up, its double-stack operations might have to be added to other double-stack operations of the two railroads.

Other Factors in Interport Container Competition. The cost of doing business at ports also affects intermodalism. Container handling costs - just one element in port costs-are of increasing concern because of the potential

impact they could have on diverting cargo to other parts. This is especially important in the case of Baltimore, New Jersey, New York and Norfolk, each vying for

Midwestern cargo, in addition to trying to hold on to cargo once considered natural hinterland cargo in and around major centers of economic activity. Cost factors include vessel and terminal leasing and operating costs, and ancillary costs such as forwarders, drayage and assessments on cargo to help pay for longshoremen benefits and guaranteed annual payments. At stake is the decision by carriers to make one or more calls at these and other ports.

Regionalization of Ports. One way to rationalze fierce and often intensive competition between ports is through regionalization. This places ports in better positions to compete with other regions along the same coastline or across the continent.

Seattle and Tacoma have proposed a joint marketing program that may involve other regional ports such as Everett and possibly even Vancouver, Canada. Los Angeles and Long Beach already are having successful experiences.

18.29 DOMESTIC CONTAINERIZATION

U.S. domestic containerization, the use of marine containers for domestic intermodal transportation, began in the 1920s. This was mainly due to a desire to provide a better quality (and more economical) service in response to truck competition. It was the piggyback service during that era, offered by a few interurban rail systems in an effort to preserve what was left of their once extensive freight service. During the 1930s, restrictive ICC regulations and railroad management inertia spelled the end for rail containerization. while on the other hand, due to the efforts of the Chicago Great western and New Haven Railroads, piggyback enjoyed a new spirit of life that assures it would be the dominant form of U.S. domestic intermodalism through the 1980s.

There were numerous attempts to revitalize domestic containerization in the 1950s and 1960s, such as American Car and Foundry's (ACF) Adapto car of 1955, REA's side-loading system of 1964 and experimentation by both New York Central and Milwaukee Road with Flexi-Van.

The Missouri Pacific and the Southern Railway in the early 1960s both recognized the advantage of containerization, using more conventional railroad hardware. However, all these systems were pushed out of the

marketplace because of limited acceptance by U.S. rail carriers and lack of universal interchange. Nevertheless, more perceptive and market-oriented rail executives recognized the advantages of containerization. It offered less capital investment, less tare weight and therefore greater fuel savings, and higher speeds (because of a lower center of gravity). It was also compatible with marine containers for international trade and avoided additional expense to improve clearances, at least for single-level containers. The introduction of double-stack equipment in the 1980s for marine containers rekindled interest in the concept of domestic containerization. This also occurred during a period when the U.S. dollar was very strong, imports (particularly from the Pacific Rim) far outweighed exports.

Many containers would have returned empty to West Coast ports if it were not for domestic cargo from the East Coast and Midwest filling and backhaul. As in the case of APL, domestic backhaul freight generated substantial quantities of traffic. Because of available backhaul and low double-stack costs. Domestic containerization became very competitive and siphoned away westbound traffic from both piggyback and highway traffic.

California shippers who were moving large quantities of product east of the Mississippi became very interested in using this service for eastbound shipments because of its low costs. A study by the Department of Agriculture completed in 1987 pointed out the advantages of double stack, but noted that high density of most agricultural products precluded use of double stacks. Two containers of such high-density products would exceed railcar weight limits.

To counter this argument the major railcar builders developed cars with heavier trucks to accommodate higher weight limits. However, this did not totally solve the problem.

Trailer Train designed a double-stack car that eliminated the articulation and moved back to the individual platform concept with a set of trucks at either end.

This design permitted haulage of two containers well above current highway weight limits, as well as being more flexible in regard to changes in capacity.

One problem the Department of Agriculture pointed out was the lack of refrigerated capacity. This situation was closely linked to the maximum weight problem when two standard refrigerated containers were placed on a double-stack car platform. APC now operates a car of their own design

where reefer units are powered by a diesel generator mounted on the end platform of one of the units and is specially supported by two trucks.

Despite lack of heavier capacity equipment to move high-density products, such as citrus fruit, canned goods, wine and lumber products, domestic loads have already begun to move east in double stacks. This trend resulted from the shortage of piggyback equipment, and several carriers are actively seeking this business.

Although domestic containerization has grown rapidly, it represents only a portion of intermodal traffic carried by railroads.Container traffic grew from 10 percent of total rail intermodal traffic in 1985 to 40 percent in 1988. However, the bulk of this containerized freight is marine bridge traffic.

The exact amount of domestic container traffic is unknown since neither the ICC nor the Association of America Railroads tracks this figure. The best estimates are that domestic containerization accounts for about 7 percent of all intermodal traffic in the United States.

18.30 The Canadian Experience

Despite the lack of double stacks and a substantial amount of piggyback traffic, a much greater share of domestic Canadian rail traffic moves by containers. This is essentially due to the fact that Canadian railroads are closed systems, and that they serve most major traffic centers over all of Canada. Since they did not have to interchange with other carriers, the equipment was under their control and they could design the equipment to suit their needs.

They chose the container system over piggyback. Canadian railroads have not had the prohibitions on rail ownership of other modes, which were similar to restrictions placed on U.S. railroads before deregulation. Canadian railroads were free to select the technology that made sense from a multimodal viewpoint. Because they owned motor carriers, they also were able to exert greater control over investments in containers.

This minimized " off-line " operations. Thus, Canadian railroads can operate their domestic operations at a full 75 percent of intermodal traffic, compared to 40 percent for U.S. traffic. This is quite remarkable in view of the fact that neither Canadian railroad operates double-stack cars. Of that portion of intermodal traffic classified as purely domestic, 22 percent moves in containers, contrasted to 7 percent in the United States. Canadian Pacific

even owns a fleet of 2,000 non-standard, 44-foot 3-inch containers for domestic purposes only.

18.31 The European Experience

Inland intermodalism in Europe is dominated by the container. Over 92 percent of intermodl traffic moving by rail in Europe moves in containers. There is piggybacking in Europe, but to accommodate highway trailers- within existing rail clearanes- they must ride in depressed wells in the railcars. In Germany, for example, the Rollende Landstrasse (Rolling Highway) truck and trailer rise is inspecially designed, low profile cars.

It is presumed that the initial interest in containers came from Conex-type boxes (see Chapter 9), shipped by the U.S. military through Europe.

The large percentage of trade moving by ocean carriers was also a factor. However, numerous passes, tunnels and other points have restrictive clearance. The standard authorized height for international loads are 12 feet 6 inches (4.13 meters) with a standard container. Even with low profile equipment, the number o routes piggyback (TOFC) can operate is severely restricted.

Europe also has seen the unusual phenomenon of wider acceptance of the strictly domestic container.

In Europe they are called "swap bodies". Little effort has been made to standardize the height, width or length of these containers. They are lightweight and of sufficient width (2.50 meters, or 8 feet 5 inches) to accommodate two standard-size European Pallets. Because they are designed for low tare weight in highway use, they are too weak to be stackable. Nevertheless, they are expanding at a rate far greater than piggyback or even the standard ISO marine container. European railroads are not only accommodating them, they are planning their intermodal systems around them.

18.32. The Demise of TOFC

Less than a decade ago the thought that conventional piggyback would be replaced by a containerized system would have been inconceivable. However, three factors have dramatically changed circumstances. This has been advanced by cost savings associated with double stacks (the two for one effect and by the internationalization of the world economy and the

necessity of trade for survival. Furthermore, the TOFC fleet is aging gradually, caused in part by inadequate earnings in TOFC service.

If U.S. railroads want to stay in the intermodal business, they face a massive reinvestment in suitable equipment. In general, TOFC equipment, which has been the backbone of high-value railroa service, is wearing out. The trailer fleet averages over 8 years in median age, many are over 20 years in service. Because of the massive reinvestment decisions at hand, U.S. railroads must determine which method they will invest in. By some measures, piggyback is the least likely form of investment.

Most industry leaders are not optimistic on the prospects for TOFC. At best, many see s downscaled role in the future. Exception is taken in short-haul, lower volume markets.

Even in these markets, however, RoadRailer technology is seen as a strong contender. Double stack is seen as completely dominating the high-volume, long-haul markets.

So far the marketplace has confirmed some of these judgments. Santa Fe Railroads, which was the only major U.S. railroads to reject double-stack technology in the early stages of development, started acquiring double-stack equipment in 1987. Sante Fe envisions TOFC as being faster, premiun service, operating in tandem with double stack. However, the railroad recently announced that it would offer major discounts in TOFC to make it more competitive.

In 1988, Burlington Northern (BN) also announced that it was phasing out TOFC service in favor of domestic containerization. This included its well know Expediter trains, which operate in short and thin volume corridors. BN may establish a number of low-volume terminals with low-capital investment in major metropolitan areas. Such a strategy would " put the terminal in the customer's backyard " and reduce costs inherent in long drayage. Several major railroads are also eliminating hindrances for double-stack operations. Conrail has been busy improving clearances between New York and Chicago and in Massachusetts and Pennsylvania. Southern Pacific is working with the port of Oakland to enlarge several tunnels in the Sierra Nevada range and examining clearance restrictions on the San Francisco peninsula. Canadian Pacific has eliminated several tunnels on its newly completed route through the Rockies permitting use of double stacks to the West Coast.

Steamship lines also have been taking an active role in double-stacking. APL recently completed a new intermodal terminal in Detroit and is working on another in Kearny, New Jersey, adjacent to the Conrail terminals. "K" Line, through its Rail Bridge subsidiary, is expanding into new terminals at Tacoma, Memphis and Elizabeth, New Jersey. For the present time, domestic double stack appears to be firming its position in intermodal freight transportation.

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